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New England Pattern Shop Is Unique

Plant Is Arranged as a Series of Producing Units Each with Its Equipment Complete — Carefully Conceived System Records Progress of Work

BY HERBERT R. SIMONDS

PATTERN shops usually are run as a side issue and, necessary adjuncts to foundries, and as such they often come second in planning, system, and general efficiency of service. Pattern shops designed as a complete unit to function independent of foundries, in a word to constitute a self contained business, are the exception rather than the rule. One such shop and probably one of the best equipped wood pattern shops in the country is that of the Bethlehem Shipbuilding Corp. at its Fore River plant, Quincy, Mass. This plant occupies the full second floor of a modern 250 x 100 foot building, the first floor of which is a joiner's shop for the manufacture of vessels' housings and trimmings. The building and equipment have been specially designed for the maximum production of first-class patterns.

Lumber Direct to Shop

The standard gage railroad system of the Fore River plant comes up to one end of the building directly under an extended overhead monorail in the pattern shop. Lumber may be brought to the plant in its original cars and lifted up by crane and transported over the monorail system to racks conveniently located throughout the shop. Lumber carts similar to those used at lumber mills form a means of transportation from one section of the room to another. The racks themselves, as shown in Fig. 4 are solid permanent features of the building and are designed for easy access to different sized boards as needed.

The scheme of manufacture of patterns is based on the group system. Each 10 or 12 work benches along the sides of the shop have conveniently located thereto a group of power machines consisting essentially of a band saw, a joiner, and a circular saw. Other tools such as cut-off saws, grinders and planers form part of the equip-

FIG. 1—ON BOTH SIDES EXTENDING THE FULL LENGTH OF MAIN ROOM ARE INDIVIDUAL WORK BENCHES PLACED AT RIGHT ANGLES TO THE WINDOWS SO THAT THE LIGHT IS TO THE LEFT OF EACH PATTERNMAKER—GROUPS OF MACHINES ARE LOCATED CONVENIENT TO EACH SET OF APPROXIMATELY 10 BENCHES

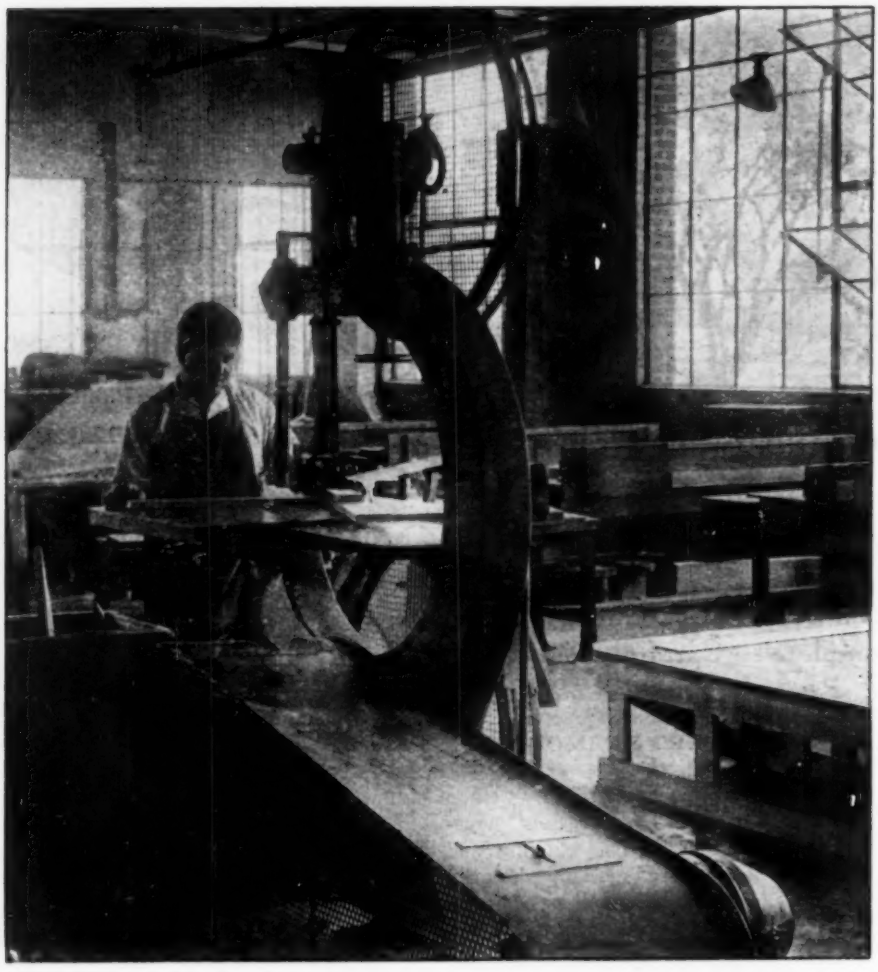


FIG. 2—THE BAND SAWS AS WELL AS ALL OTHER POWER DRIVEN TOOLS IN THE SHOP ARE COMPLETELY EQUIPPED WITH SAFETY SCREENS

ment in many cases. The shop may be said to be divided into four departments as follows:

Office or control.
Manufacturing groups.
Gluing and finishing section.
Shipping section.

The sequence of pattern manufacture follows through these groups. It starts with the order and plans at the office, then to one or more of the manufacturing groups, then to the gluing and finishing section, and finally to the shipping department.

When a pattern is desired, the plan and other fundamental information orignates at the engineering department of the shipbuilding yards. As soon as a plan for a pattern is completed it is sent to the office of the pattern shop. On its receipt it is entered on a blue print index card similar to that shown in Fig. 8. This card has copied on it from the blue print itself, the shop number, the drawing number, the name and the drawer where the blue print has been filed. When the actual work is to start, a form, shown in Fig. 11, issued by the order department and sent to the pattern office. This form has been approved and constitutes the final authority for proceeding with the work. It is issued independent of blue prints but contains data sufficient for the location of any blue print or pattern. When it is received at the pattern shop office the first duty of those in the office is to search through a pattern inventory file which contains a card for every pattern ever made by the shop. These cards are kept up to date and contain, as shown in Fig. 9, information concerning the material, the drawing number, the number used per boat, (in case it is for a boat) the date completed, the cost, and other items. The reverse side of the card indicates the disposition of the patterns so that when an order is issued the office is able to tell quickly whether a pattern is available or whether a new

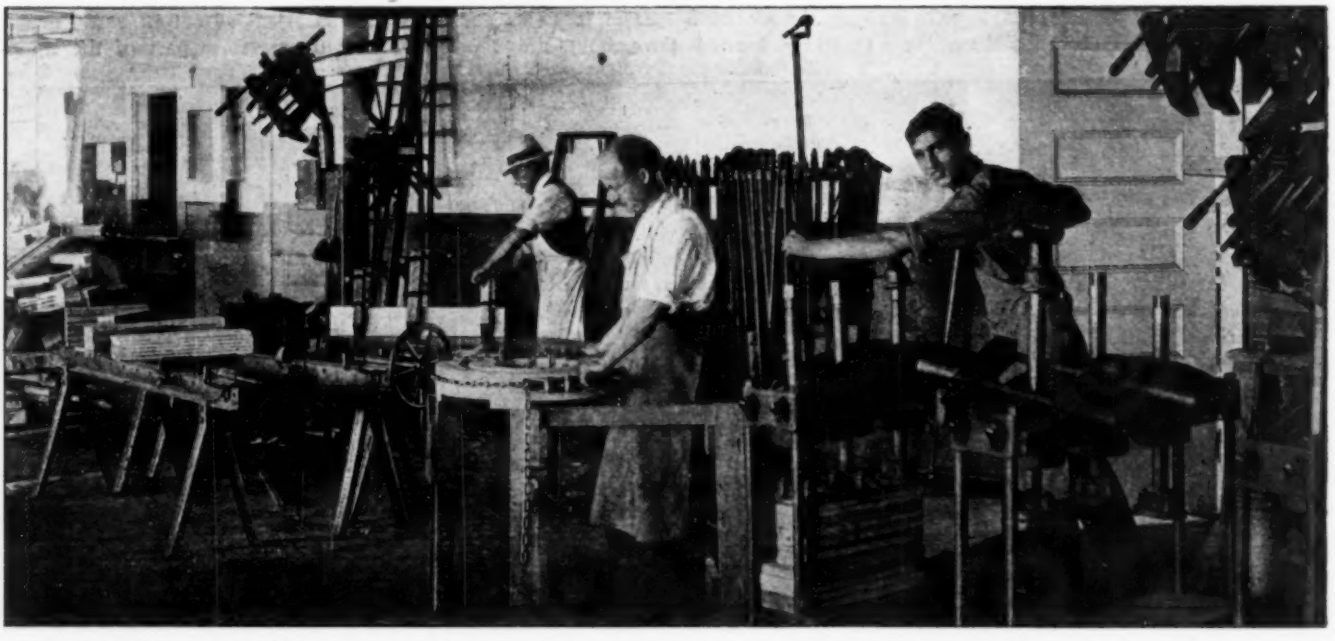


FIG. 3—THE GLUING DEPARTMENT IS WELL EQUIPPED—IN THE BACK GROUND IS THE STEAM TABLE WITH ELECTRICALLY HEATED GLUE POTS AT THE LEFT—THE CLAMP TREES MAY BE SEEN IN THE RIGHT BACKGROUND WITH SPECIAL CLAMPS IN THE FOREGROUND —THE OPERATOR IN THE CENTER IS ADJUSTING A CHAIN FORM OF CLAMP WHICH IS EXTENSIVELY USED IN THIS SHOP ON CIRCULAR WORK

pattern must be made for the job.

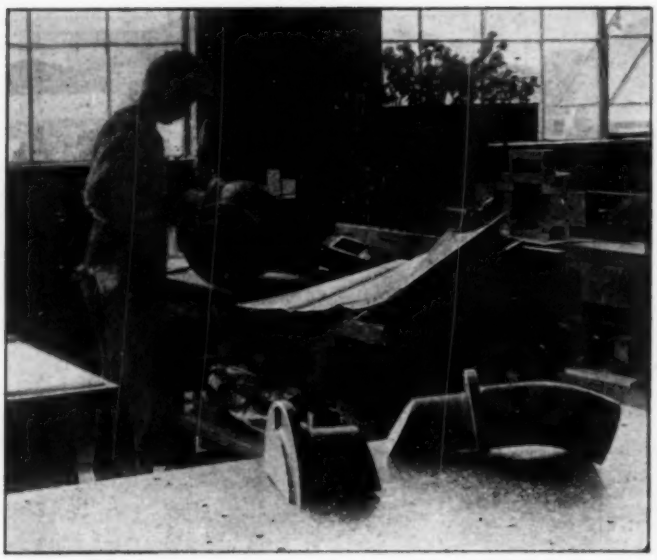
The pattern shop furnishes wood patterns for all the shipbuilding company's foundries, and thus only a limited portion of the total number of patterns made is on hand in the storage house which is at Braintree, Mass., a few miles from the Fore River plant. In the pattern shop itself, forming a part of the shipping room, is located small pattern storage consisting of shelves properly marked and sub-divided for convenience in filing and locating patterns. This storage space is used largely for small work and for patterns which continually are being used in the Fore River plant foundry or other nearby foundries. A card as shown in Fig. 10 is made out for patterns stored in this space. This card shows the aisle, the shelf and the section where the pattern is stored, together with the number of pieces and other information. The duty of a storage attendant is to see that the number of pieces returned from any source corresponds with the number shown on the card and that these all are filed in the section noted. When the patterns are delivered from the shop to a foundry a form is made out similar to that shown in Fig. 12. This particular form is for the foundry at the Fore River plant and is intended to follow the patterns to the foundry and back to the pattern maker for receipt when patterns are returned.

It may be noted in Fig. 9 that the total number of hours and the cost of each pattern is listed. The labor cost is obtained by having each pattern maker fill in a time card similar to that shown in Fig. 13. This card shows the job and drawing number on which the man has worked as well as the number and time spent on machines.

When the order for a pattern is received and a search of the files reveals that the pattern either has not been made or is not available, the blue print is taken from the files and together with a shop order is given to a pattern maker who has charge of

FIG. 5—ON SPECIAL PATTERN WORK FOR LARGE DIE MACHINES, THE FEMALE SECTION OF THE PATTERN IS CONSTRUCTED FROM THE MALE DIRECTLY WITHOUT THE USE OF DRAWINGS —THE ILLUSTRATION SHOWS THE FEMALE PART IN COURSE OF CONSTRUCTION

FIG. 4—THE OVERHEAD MONORAIL WHICH RUNS THROUGHOUT THE SHOP EXTENDS OUT AT ONE END OVER A STANDARD GAGE TRACK—AT THE RIGHT ARE THE PIPE RACKS WHERE DIFFERENT SIZES OF BOARDS ARE STORED



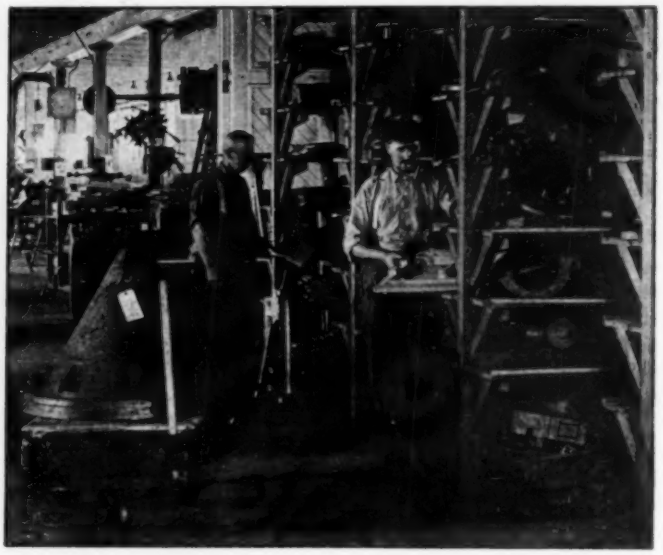


FIG. 6—ON COMPLICATED PATTERN WORK IT OFTEN IS NECESSARY FOR THE PATTERNMAKER TO REFER CONSTANTLY TO DRAWINGS AND IN SOME CASES MAKE LAY-OUTS FOR HIMSELF—THE PATTERNMAKER HAS A REGULAR DRAFTING TABLE OPPOSITE HIS WORK BENCH FIG. 7—AT ONE END OF THE SHOP STORAGE RACKS ARE PROVIDED FOR THE SMALL PATTERNS USED IN THE YARD FOUNDRY—EACH SHELF IS DIVIDED INTO SECTIONS AND A CARD INDEX IS KEPT SO THAT EVERY PATTERN STORED MAY BE READILY LOCATED WITHIN A SPACE APPROXIMATELY TWO SQUARE FEET

the work. On small patterns where there is no rush it is the practice to have each man complete his work independently. On large units, however, where three or four or more may be on the same job, some one is picked as the temporary foreman and is given the responsibility of laying out the work and keeping track of its proper execution. When the different parts forming a pattern are ready for bluing, they are marked properly to indicate their position in the finished pattern and if of convenient size they are placed on light double-deck hand carts and later are taken to a centrally located section where the principal gluing operations are performed. It is advisable in some work to glue parts during their construction and for this purpose several electrically heated glue pots are located throughout the shop.

The central gluing section is especially well equipped. A flat steel surface steam table is used for laying out the pieces and applying the glue. By having the surfaces to be glued warmed on the steam table previous to applying the glue, better penetration and much better results are obtained. A standard, carrying four electrically heated pots is located conveniently at the left of the steam table. To the right of this table stands a clamp tree which has proved a great convenience and time saver. Ordinarily clamps for gluing purposes are scattered over a wide area and must be rounded up for each job as it develops. With the clamp tree employed all clamps after using are hung up at one point and in this way are accessible and convenient when needed. Some distance in front of the hot table are metal horses where work may be laid out or left after gluing and clamping to be carted away. The double-deck, light carts which are used have been found exceedingly serviceable. Where a pattern maker has many pieces to use at his bench, the upper deck of the cart which is level with his bench forms a convenient tray or storage and obviates stooping to the floor. In complicated pattern work it often is necessary to study plans in connection with the actual work as it progresses on the bench and for this class of work an arrangement such as is shown in Fig. 6 is employed. Here the pattern maker has a drafting table on one side of him and a bench on the other, both well lighted from the window at his side.

All benches in the shop are arranged extending out into the room from the windows, with the operators left hand toward the window. This gives good light over the man's left shoulder and has the added advantage of separating each bench from the others and so reducing the temptation to visit which often is notice when benches are placed back to back. Safety devices throughout the shop have been given special consideration. A safety committee of three members is appointed every three months and much

BLUE-PRINT INDEX

Drawing No. Job No.

Drawing Name

Drawer No.

Date Issued	Dep't	SENT TO	Date Ret'd	Destroyed or Stored
Form 105				

BETHLEHEM SHIPBUILDING CORP., LTD. PATTERN INVENTORY

Pattern No. Change No.

Name

Material Drawing No. No. Per Boat

Weight Each Order No. Date Completed 191

Mahog.	Made by	Total No. Hours	Cost	Inspected by
Pattern Pine				

No. of Pieces in Pattern

No. of Core Boxes No. of Pieces in Core Boxes

Remarks

FIG. 8—AN INDEX CARD IS FILLED IN FOR EACH BLUE PRINT RECEIVED AT THE PATTTRN SHOP FOR USE IN REFERENCE AND IN LOCATING PRINTS WHEN PATTERNS ARE TO BE MADE FIG. 9—PATTERN INVENTORY CARDS ARE KEPT OF EACH PTTTERN MADE—THESE CONTAIN THE COST AND ALL OTHER INFORMATION CONCERNING THE PATTERN—THE REVERSE SIDE SHOWS THE DISPOSITION SO THAT ANY PATTERN MAY BE READILY LOCATED

FORE RIVER SHIPBUILDING CORPORATION — PATTERN INVENTORY

PATTERN NO. CHANGE NO.

NAME

AISLE SHELF SECTION

MATERIAL

WEIGHT EACH

NO. OF PIECES IN PATTERN

NO OF CORE BOXES NO. OF PIECES IN CORE BOXES

REMARKS.

Form 218.

RECEIVED	DELIVERED TO	SHIPPED 191	RETURNED 191	CASTINGS ORDERED	JOB ORDER

FIG. 10—A STOCK INVENTORY CARD IS KEPT ON THIS FORM FOR PATTERNS STORED IN THE FORE RIVER STORAGE ROOM

interest and enthusiasm in this work is found among the men. The Massachusetts industrial board in its last report gives this pattern shop the highest rating of any wood-working shop in the state of Massachusetts. Every part of every machine which might in any way prove hazardous is guarded. Compressed air is piped to each individual machine for cleaning out the shavings, and an exhauster system of piping similar to that used in modern lumber planing mills extends throughout the shop to collect the shavings.

The shavings are carried up overhead and through large pipes to an incinerator outside the building. Thirteen floor outlets are included in the shaving collector system as well as the outlets at machines so that any shavings which do get down to the floor may be swept to one of these outlets and thus carried to the incinerator. The floor is made of matched maple with a smooth surface which makes for cleanliness. The machines are operated by direct connected motors.

Portable tools are available for special classes of work. These include electric drills and pneumatic chipping machines or gouges for taking down large sections of work where the saw or planer cannot be used. However, the foreman of the shop discourages too great a use of these pneumatic tools. If a certain pattern has a depressed portion it often saves time to cut this piece into sections which can be formed with a band saw or other tool and later to glue them together.

A tool and supply room with an attendant is maintained near the center of the shop. Here all supplies such as sand paper, files, grinding wheels, and a large assortment of special tools are kept. It is the duty of the tool attendant to keep all band and circular saws sharpened and the tool room is equipped for this work. Feeling that the condition of tools is one of the most important features in any wood shop, the foreman has placed an experienced man in charge of all the power driven tools. He sees that each machine is in correct working order at all times.

Suggestions for improvement throughout the shop are encouraged and have brought forth many innovations in equipment and methods. In connection with the gluing operation one man suggested a chain clamp somewhat similar to a pipe chain tong only for use on sections of 4 or 5-foot diameter. Before the adoption of this clamp, it was the usual custom when gluing together segments of a circular piece to wrap them with a rope and then by inserting a short stick at one point to twist until the desired tension was obtained.

BETHLEHEM SHIPBUILDING CORPORATION, LTD.

FORE RIVER PLANT
BILL OF MATERIAL

ISSUED BY Order DEPT

MADE BY HMM/ANK CHK/RAM DATE 6/1/20 APPROVED W.H. [illegible]

SHOP WASTE & MFG. SPOILAGE	MK. NO.	QUANTITY REQ. (EACH)	(SETS)	TOTAL	MATERIAL	DESCRIPTION	PATTERN OR DIE NO.	PATT. CHANGE	REQUISITION NO.	ROUTING	REMARKS
						MISCELLANEOUS	TOTAL WT. LBS.				Navy Dept Leaflet Spec
43.7%	5			208	Ni. Steel 3½%	Nickel Nozzle Plate L.H.	SU606		CFS-4146-B	W.M.A.G	48-5-6-A Sept 1, 1917
						8 - 1/16" X 5 3/16" X 3/16"					
						Make from 173 FT. 5 3/16"					
						X 3/16"	572#				
43.7%	6			208	Ni. Steel 3½%	Nickel Nozzle Plate R.H.	SU606		"	"	48-5-6-A Sept 1, 1917
						8 - 1/16" X 5 3/16" X 3/16"					
						Make from 173 FT. 5 3/16"					
						X 3/16"	572#				
33.1%				16	Comp'N'k	Key for Diaph. 1/2" X 23/32"					
						X 8-3/16", Make from stock					
						5/8" X 7/8" X 13'-4"	22.7#		CFS-2147-C	"	46-8-6-E Feb 1, 1919
2.4%	8			64	Comp'N'k	5/8" Angle Section			"	"	46-8-6-E Feb 1, 1919
						("7 B.S. Guage .0143")					
						25" Long Make from 16					
						pcs. 8'-3" Long.	92.7#				
None	9			32	Comp'N'k	1/4" U.S.S. Flat Hd.				"	
						Mach. Screw 1" Long	.58#				
15.4%	10			320	Comp'N'k	1/4" U.S.S. Thd. Pin				"	
						11/16" Long. Make from					
						23 Pieces 12" Long	4.08#				
						Material & Inspection to be in Strict Accordance					
						with Navy Dept Leaflet Spec. as Listed above.					
						Quantities Listed above are for Hull 1382.					
						Duplicate for Hull 1383 (2 Boats)					
						U.S. Scout Cruisers #7 & 8.					

B/M No. U85-17809 2 SHEETS SHEET No. 2

JOB No. 320

PLAN No. E1382-320-3/2

TITLE 2nd Stage Nozzle Diaph. for L.P. Turbine

NO.	REMARKS	APPROVED DATE	APPROVED BY

S

FIG. 11—THE AUTHORITY FOR STARTING WORK ON ANY PATTERN IS ISSUED IN THIS FORM WHICH IS SEEN TO INCLUDE COMPLETE DATA COVERING THE MATERIAL DESIRED—ONE COLUMN GIVES THE PATTERN NUMBER WHICH IS SUFFICIENT FOR LOCATION OF BLUE PRINT OR PATTERN IN THE SHOP

Form S-21

PATT. NO. JOB NO.

PATT. CH. DATE 191

PATT. NAME

DR. NO. SCH. NO.

Bethlehem Shipbuilding Corporation, Ltd.

TO THE FOREMAN OF FOUNDRY

MAKE CASTINGS AS PER FOLLOWING ORDER AND DELIVER TO DEPARTMENT INDICATED, TAKING FOREMAN'S RECEIPT ON THIS CARD. RETURN PATTERN TO PATTERNMAKER, TAKING HIS RECEIPT ON THIS CARD; THEN PUNCH CARD YOURSELF AND RETURN PROMPTLY TO ACCOUNTING DEPT.

ORDERED BY

QUANTITY

METAL GLASS

PATTERN PIECES CORE BOXES

FOR

COMPLETED 191 FOUNDRY FOREMAN.

RECEIVED 191

WEIGHT LBS. FOREMAN

PRICE PER LB. AMOUNT $

PRICED BY POSTED BY

RECEIVED THE PATTERNS USED ON ABOVE ORDER

191

PATTERN FOREMAN

RECORD OF DELIVERIES

DATE	QUANTITY	WEIGHT

FIG. 12—WHEN THE PATTERNS ARE DELIVERED TO A FOUNDRY THIS FORM IS MADE OUT WHICH IS EXTENDED TO FOLLOW THE PATTERNS ON THEIR COMPLETE COURSE UNTIL THEY ARE RETURNED TO THE PATTERN SHOP

The new method is much simpler and quicker. The chain is wrapped around the piece which has been glued and then the proper link placed over the hook on the clamp, when a few turns on a turn buckle give the desired compression.

The waste due to small blocks in a pattern shop is usually large and to overcome this, the gluing department has been assigned the job of gluing together small pieces to form material of suitable size for use in the regular pattern work. These built up pieces are used in exactly the same way as new stock would be and have proved entirely satisfactory. The shop itself is unusually light and clean and the welfare of the workers is given constant attention. At the base of each window, surrounding the entire room, a flower box is kept filled with plants and flowers. At first though this is scarcely to be associated with the wood working shop, but it nevertheless is a feature which adds materially to the general pleasant atmosphere. The shop is designed for 100 pattern makers.

Because of the fact that a large portion of the patterns is sent to outside foundries it is necessary to have the pattern work itself come up to a higher standard than otherwise would be the case. Each pattern must, as nearly as possible be self-explanatory and complete. On large work it often would be common practice to mold some surfaces directly in the sand without patterns but this cannot be done when the foundryman who uses the pattern may be hundreds of miles away without any other knowledge of the piece he is to cast than that indicated by the pattern itself.

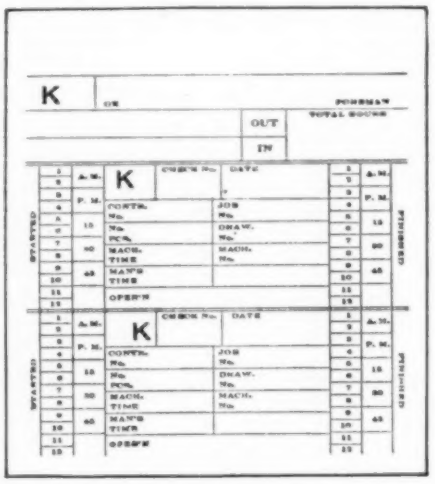


FIG. 13—A DETAILED COST SYSTEM IS USED TO DETERMINE THE LABOR CHARGE AGAINST INDIVIDUAL OPERATIONS

Standard colors in painting the patterns have been adopted in accordance with general practice. Cores are painted black, surfaces which are to be finished red, and all other parts white. Painting and finishing is especially well done and the patterns in the shipping room ready to be boxed or crated have the same appearance as the highly polished boat fittings which are made in the joiner's plant on the floor below. Considered as a whole, the Fore River pattern shop embodies the most modern equipment and the best known practice.

White pine is used almost exclusively, the only exception to this being mahogany in some cases where added strength is necessary. Outside of the building near the entrance where lumber is brought into the shop, is an up-to-date kiln for drying and preparing the lumber for the pattern work. The pattern costs compare favorable with those of other shops but are higher than they might be in the present shop if cost was the prime consideration. The management believes that good patterns pay for themselves many times over and accurate work is insisted upon throughout the whole organization.

Transportation Governs Iron Costs

Freight Charges Which Have Increased 120 Per Cent on Raw Materials for Mahoning Valley Form Obstacle to Early Decline to Previous Low Levels

BY C. J. STARK

HOW far will the present decline in pig iron prices go before the point of stabilization shall have been reached? May we expect a return to the low-priced levels brought forth under depressed trade conditions of pre-war years as in 1912 and 1914 when $12 Buffalo, and $12.50 valley, manifestly rock-bottom cost figures for the most favored producers made their appearance? If not, what are the preventing factors?

These questions are pressing for an answer in the minds of every pig iron buyer at the present time. Clearly there is a common and understandable expectation among those who are consumers of iron that the point of ultimate price recession, still is some distance away. Likewise this view is shared by many financial and economic authorities. Because of this situation, a comprehensive analysis of the economic conditions surrounding the manufacture of pig iron at the present time is highly pertinent and important.

That the costs of production of iron today are much higher as compared with seven or eight years ago, admits of no or small question in the light of the common experience of manufacturers in all lines. In what form and proportion this increase has come about, however, and the probable way in which it shall be affected by the deflation process now in progress, with its consequent reaction on prices, are offered the real and vital salients of this study.

Examination of the factors of furnace cost leads immediately to a recognition of the dominating importance of two factors, transportation and labor, due to the repeated advances of wages and freight rates in recent years. Of these two elements the transportation item because of its surprisingly large amount and its peculiar character as a substantially fixed charge takes first rank. This is clearly shown by typical example. Under freight rates now in effect the assembling cost alone of all raw materials in the Mahoning valley, sufficient for the production of one ton of pig iron, is $10.55. In 1912 it was $4.79. This represents an increase of $5.76 or 120 per cent. This compilation is based on a usual mixture of 60 per cent Mesabi and 40 per cent other Superior ores, of Connellsville coke and of nearby limestone and in the proportions of 2 tons of ore, 1.11 tons of coke and 0.54 ton of limestone, which are the standards adopted by the government in working up similar data. Of this increase $3.04 per ton is represented by the transportation on ore from lower lake ports to the furnace, on coke from the Connellsville region and on limestone from a local point. Of the remainder, $2.42 is due to higher rail, vessel and handling charges on ore from the Lake Superior mines to lower lake docks. A new item of 30 cents per ton for war tax then is to be added.

A comparison of assembling costs in tabular and detailed form, taking the ore at lower lake ports, is as follows:

Jan. 1, 1912

Ore (2 tons)	$1.12
Coke (1.11 tons)	1.50
Limestone (0.54 ton)	.18
	$2.80
Transportation on supplies (estimated)	.05
Total	$2.85

Jan. 1, 1921

Ore (2 tons)	$2.05
Coke (1.11 tons)	2.81
Limestone (0.54 ton)	.83
	$5.69
Transportation on supplies (estimated)	.20
Total	$5.89

The item of freight on supplies shown in the foregoing table includes the haul on coal, fire clay, sand, brick and other miscellaneous needs of a furnace plant.

The comparative rates on iron ore per gross ton from the various Superior mining districts to lower lake ports, those by rail and vessel being separated are shown in the accompanying table.

On the basis of two tons of a mixture of 60 per cent of Mesabi and 40 per cent of other ores, necessary to make a single ton of pig iron, the consolidated transportation cost from the mines to lower lake ports in 1912 and 1920 is as follows:

	1912	1920
Mesabi	$1.26	$2.48
Gogebic, Marquette, Menominee	.68	1.88
Total	$1.94	$4.36

The comparative transportation cost of assembling all raw materials sufficient to make one ton of pig iron in the Mahoning valley, the ore haul being divided into the items of mines to lower lake port and lower lake port to furnace, is as follows:

	1912	1920
Raw material assembling (ore from lower lake docks to furnace)	$2.85	$5.89
Ore, mine to lower lake dock	1.94	4.36
War tax	...	.30
Total	$4.79	$10.55

This table shows that while in 1912 the transportation cost on the ore from the mines to the lower lake ports was larger than the assembling costs at the furnace, the latter including ore based at lower ports, it now is considerably smaller.

This total transportation cost for the assembling of raw materials in the Mahoning valley is further increased by the item of dock storage charges on ore for approximately three months of the year, or on about 20 to 25 per cent of the tonnage consumed. This charge in 1912 would have worked out roughly about 1.33 cents per ton for a furnace taking in tonnage at a uniform rate throughout the year. Due to the increase in these charges since 1912, the item today amounts to approximately 7 cents per ton. The total dock storage and handling charge in 1912 was 8 cents per ton; in 1920 the comparative figure was 41 cents per ton.

The prevailing freight rates on direct iron ore from lower lake ports to the Mahoning valley from 1913 to date are as follows: Jan. 1, 1913; $0.56; June 6, 1917, $0.73; Aug. 25, 1920, $0.99; Sept. 26, 1920, $1.025. These rates included the war tax of 3 per cent on freight charges.

The rail rates on furnace coke per ton from the Connellsville region to the Mahoning valley on Jan. 1, 1913, was $1.35, but this was readjusted by the interstate commerce commission, Aug. 1, 1913, to $1.20 in order to maintain existing relationships. Subsequent changes were: July 15, 1917, $1.35; July 25, 1918, $1.80 and Aug. 26, 1920, $2.52. The increase in the coke rate figuring on the readjustment of Aug. 1, 1913 to Jan. 1, 1921 therefore has been $1.32 per ton or 110 per cent. Approximately similar percentages of increase have applied to limestone, largely a local proposition.

Another major factor in the increase

of pig iron production costs between 1912 and 1920 is labor. In the period in question common furnace labor in the Mahoning valley and surrounding districts has increased 214 per cent. While the flat per hour rate has not been raised to that amount, having gone from 17 cents to 46 cents per hour, the added increase has come about through the adoption of the basic 8-hour day two years ago and the payment of time and one-half for overtime. At 46 cents an hour, this works out to 53.66 cents per hour, for a 12-hour day which remains the general working period.

The various hourly rates in cents for the common labor at furnaces in the Mahoning valley and surrounding districts since 1912 with the dates of change are as follows:

Jan. 1, 1913	17
Feb. 1, 1913	19
May 1, 1916	25
Dec. 1, 1916	27½
May 1, 1917	30
Oct. 1, 1917	33
April 16, 1918	38
Aug. 1, 1918	42
Oct. 1, 1918	—*
Feb. 1, 1920	46*
Jan. 1, 1921	46*

*Eight-hour day with time and one-half for overtime. Actual wage for 12-hour day on Oct. 1, 1918, became 49 cents. At Feb. 1, 1920, increase, actual rate became 53.66 cents.

In 1912, labor cost per ton of pig iron at modern plants of large size in the Mahoning valley and surrounding territory commonly was around $1 per ton. Today on the basis of the increased rate of wages, it is not less than $3 and more in numerous cases. The $3 labor cost per ton of iron is said by furnace operators to be conservative. Likewise some plants had more than $1 cost in 1912.

On the basis of these figures it is shown that labor and transportation cost today alone represent an outlay of something like $13.50 per ton of pig iron and this before anything is said about raw materials or the usual necessary charges incident to a manufacturing proposition. This fact is all the more striking when it is considered that the sum of labor and transportation costs exceeds by $1 or more the market price in the Mahoning valley on basic and No. 2 foundry iron in 1912 and exceeds by $1.50 or more, the low point of sales made in the Buffalo district at about the same time.

Reduced to tabular form the figures of labor and transportation cost per ton of pig iron in the Mahoning valley in 1912 and 1920, would appear as follows:

	1912	1920
Transportation cost	$4.79	$10.55
Labor cost	1.00	3.00*
Total	$5.79	$13.55

*Estimated.

For a complete production and operation cost of pig iron, there is yet to be added to these figures the cost of ore, coke, limestone supplies, overhead, relining reserve, depreciation, interest on the investment, selling expense, taxes, etc. Obviously these will vary with different plants but the final result would not be much different. Lakefront furnaces escape the transportation charge on ore from lower lake docks but against these have a longer haul on coke, coal, and some other supplies.

The increased freight and labor factor also have their influence on the items of furnace expense set aside over and above materials charged. Because of this greater amount, it has been necessary to enlarge these allowances in corresponding fashion to cover additions to cost. The extended way higher costs are brought by charges in freight and labor rates is illustrated by the readjustments.

The spread between iron ore prices at the mines in 1912 and 1920 is given below, the freight by rail to upper lake port and vessel from upper lake port to lower lake port being eliminated. The grade of ore compared is Mesabi nonbessemer. Other grades are in similar proportion.

	1912	1920
Lower lake prices	$2.85	$6.55
Freight to lower lake port	1.05	2.31
Prices at mines	$1.80	$4.24

How the increased prices of iron ore from 1912 to 1920 are related to the increase in labor rates is to be seen from the daily wages for common labor paid at the Superior mines in that period with the dates of change. Up to Oct. 1, 1918, a 10-hour day prevailed. On Oct. 1, 1918 and subsequently the basic 8-hour day was effective, which resulted in 12 hours pay being paid for 10 hours of labor. The effect of this was that the 44 cent hourly rate was raised to 48.4 cents. On Dec. 1 1920, the hourly rate for a basic 8-hour day was raised to 48½ cents with the overtime addition continued. This caused the actual hourly rate for a 10 hour working day to be raised to 58.2 cents per hour. The advance in 12-hour daily wages from 1912 to 1920 is 206 per cent.

The changes in the common labor wages per day at the ore mines is as follows:

Jan. 1, 1913	$1.90
Feb. 1, 1913	2.10 to 2.25
Jan. 31, 1916	2.25 to 2.40
May 1, 1916	2.60
Dec. 15, 1916	2.85
May 1, 1917	3.15
Oct. 1, 1917	3.45
April 1, 1918	4.00
Aug. 1, 1918	4.40
Oct. 1, 1918	*4.84
Feb. 1, 1920	*5.82

*Basic 8-hour day in effect with time and one-half for overtime.

Ore operators point out that these increases have been accompanied by decreased efficiency in per man production, further adding to the labor cost per ton of iron ore.

A recent reduction of 15 per cent in wages effective generally Feb. 1 has been announced by the merchant ore operators. One large operator estimates that this cut will mean a reduction of 28 cents in the cost of producing a ton of iron ore.

Connellsville furnace coke prices show an advance of $1.50 per ton between the dates of Jan. 1, 1913, to Jan. 1, 1920. A comparison of the prevailing market prices at the ovens on 48-hour coke on these two dates is as follows:

Jan. 1, 1920	$5.00
Jan. 1, 1912	1.85
Advance per ton	$3.15

A similar situation of greatly increased labor costs is to be found in coke by reason of the advanced wages at ovens and coal mines.

Likewise it has applied to limestone costs. These increases are reflected in market prices on coke and limestone.

The present distribution of production expense in pig iron makes clear the directions in which substantial revision must be expected if costs are to be materially reduced and iron prices of prewar years restored. A certain amount undoubtedly may be contributed by raw materials and some by labor. A movement in this direction already is progressing. But it requires little emphasis to show that transportation cost plus taxes by reason of the various and compounded increases in the past three or four years has become the key factor. This has been the inevitable outcome of such rate advances, when applied to an industry of the character of pig iron with its tremendous consumption of tonnage materials assembled from long distances. Equally important in this connection is the fact that rail freight

(*Concluded on page* 165)

Comparative Rates on Ore from Superior

	1912			1920			
	Rail mine to dock	Vessel dock to dock	Total	Rail mine to dock	Vessel dock to dock	War tax	Total
Mesabi	$0.55	$0.50	$1.05	$1.00	$1.24	$0.07	$2.31
Gogebic	.45	.50	.95	.85	1.24	.07	2.16
Marquette	.35	.45	.80	.65	1.14	.05	1.84
Menominee	.45	.35	.80	.85	.95	.05	1.85

Experiments on Cupola Malleable

Cupola Melted Metal Holds Many Points of Difference and Peculiarities in Handling When Compared With the Air Furnace Product —Annealing Procedure Studied

BY F. H. HURREN

SINCE the commencement of the present century, all the branches of the British foundry trade have made great strides in scientific development, but I think it will be agreed that the malleable iron industry in this country has shown the least progress.

Consider the causes which contribute to this regrettable state of affairs. The most potent factor has been the spirit of secretiveness which has prevailed among the many firms engaged in the industry, and the air of mystery with which many have surrounded their processes. This secretiveness gradually is being eliminated, but even now there is not that frank co-operation which alone tends toward real progress. Much of the malleable iron casting tonnage which makes up the output in Great Britain, is produced in small shops. In the Birmingham district a number of malleable iron foundries make up an important industry although the individual output is relatively small. Hampered by their small output, they are unable, or unwilling, to utilize scientific experiment, and it is this inability to co-ordinate science and industry which has retarded progress to an alarming extent. Again, the scientific work on malleable iron which has been published, is scattered so widely through the technical journals and the proceedings of various technical societies, as to make it quite a task to find just what work has been done.

Therefore, malleable iron is looked upon with a certain amount of suspicion. It is to be hoped that the recently formed Malleable and Cast Iron Research association will change this state of affairs, and place the malleable iron industry in Great Britain in at least as important a position as it occupies in America.

At the works which I represent, experimental work on malleable iron has been conducted regularly for years. Much of this has been routine work; some has been on purely experimental lines. The details which I give here, do not represent the only work which has been carried out, nor, on the other hand, do they represent all the work conducted. Many of these experiments have been repeated several times, and these are only typical examples. They have been carried out under ordinary works conditions entirely, and not under purely laboratory conditions. All mixtures have been melted in the cupola, all annealing conducted either in the works annealing furnaces, or in a smaller furnace specially installed in the foundry for experimental purposes. Temperatures have been taken by a thermocouple, of the type fitted as standard in our annealing ovens, and in most cases in conjunction with a thread recorder.

The analysis of three samples follows:

	1 Per cent	2 Per cent	3 Per cent
Total carbon	2.32	1.60	1.25
Comb. carbon	1.27	0.78	0.61
Graphite	1.05	0.82	0.64
Silicon	0.62	0.59	0.56
Sulphur	0.30	0.30	0.22
Phosphorus	0.08	0.08	0.09
Manganese	0.04	0.05	0.05

All of these were cast out of the same shank, in the same flask, and were identical in size and shape. The iron was melted in the cupola from a mixture of 25 per cent spotted white pig, 25 per cent gray pig, and 50 per cent scrap and sprues from previous cases. The samples were packed in separate pans in a mixture of six parts of black ore to one part of red. All the pans were placed in the furnace together which was heated up to 1000 degrees Cent. over a period of 24 hours, and then maintained at that temperature. Sample No. 1 was removed from the furnace after standing 72 hours at 1000 degrees Cent; No. 2 after 96 hours, and No. 3 after 120 hours. No. 1 was on the hard side, and not of good machining quality. Nos. 2 and 3 both were soft, easily machinable, and it was impossible, in ordinary machine-shop practice to detect any appreciable difference. You will notice the marked differences in the total carbon and in the combined carbon content. In samples Nos. 2 and 3 the proportions of combined and free carbon are almost the same, and I have noticed many times, that where the free carbon equals the combined carbon, no matter what the percentage, a good soft, machinable iron results.

The following table gives analysis of two samples, identical in composition when cast, annealed for the same length of time, and at the same temperature, namely 120 hours at 980 degrees Cent., slowly cooled during 24 hours to 900 degrees Cent., and then at a slightly quicker rate.

	4 Per cent	5 Per cent
Total carbon	1.61	2.09
Comb. carbon	0.57	0.98
Graphite	1.04	1.11
Silicon	0.77	0.74
Sulphur	0.30	0.28
Phosphorus	0.07	0.07
Manganese	0.09	0.09

The variable factor in this case was the packing medium. No. 4 was packed in a mixture composed of six parts of black ore to one part of red ore. No. 5 was annealed in this mixture of ore to which 20 per cent by volume of common washing soda had been added. Both resulted in soft castings, with the balance in favor of No. 4. This, as you will see, contains less total carbon, and considerably less combined carbon than No. 5. I do not recommend washing soda as an addition to the annealing ore, owing to the great difficulty of cleaning the castings. The soda caused the ore to cake, and it required considerable effort to get the castings out of the annealing pan.

The results obtained after the introduction of steel scrap into the malleable iron are shown in the following table:

	6 Per cent	7 Per cent
Total carbon	2.25	2.05
Comb. carbon	0.83	1.01
Graphite	1.42	1.04
Silicon	0.99	0.76
Sulphur	0.25	0.22
Phosphorus	0.08	0.10
Manganese	0.28	0.32

The mixtures were melted in the cupola, No. 6 being an admixture of 60 per cent gray malleable pig, 20 per cent spotted white pig and 20 per cent steel scrap in the form of short ends from bars. No. 7 consisted of an admixture of 50 per cent gray pig and 25 per cent each spotted white pig and steel scrap. Both samples were annealed in the same pan, and the treatment was 40 hours heating up to 950 degrees Cent., when the temperature was maintained at that point for a further 100 hours, followed by slow cooling. Both samples gave good results, and so far as I can see there are no practical difficulties in using steel scrap.

Further experiments were done in connection with the introduction of

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A paper presented at a recent session of the Birmingham branch of the Institution of British Foundrymen. The author, F. H. Hurren, is connected with the Rover Co., Ltd., Coventry, England.

steel scrap, and the following table gives the analysis:

	8 Per cent	9 Per cent
Total carbon	2.83	2.96
Comb. carbon	2.68	2.51
Graphite	0.15	0.45
Silicon	0.64	1.03
Sulphur	0.25	0.22
Phosphorus	0.07	0.07
Manganese	0.24	0.27

Sample No. 8 was cast from a mixture of 25 per cent gray pig, 50 per cent spotted white and 25 per cent sprue and scrap from a previous cast. Sample No. 9 was cast from 50 per cent grey pig, 16 per cent spotted white and 34 per cent steel scrap. Both samples were annealed together as in the previous experiment, but withdrawn from the furnace after 60 hours at 950 degrees Cent. As may be imagined from the analysis, both were hard, due chiefly to the shortness of time allowed for heat treatment.

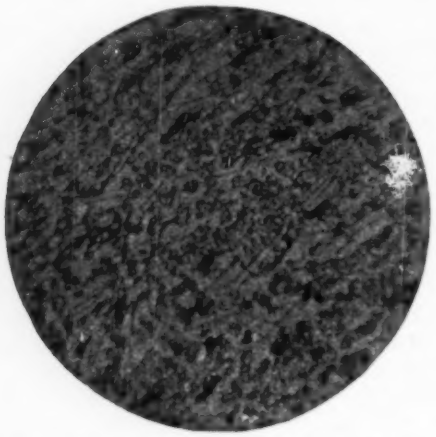


FIG. 1—SAMPLE A SHOWS CEMENTITE STRUCTURE DIFFERING FROM WHITE IRON—X 75 DIA.

No. 8 was practically un-machinable, but No. 9 could be turned or drilled at slow speed. The reason for No. 9 being the softer, lies in its higher silicon content, and is not due in any measure to the presence of steel scrap. I have proved to my own satisfaction that malleable pig will take up to 25 per cent steel scrap without detriment, provided the silicon content of the resultant mixture is not allowed to fall below 0.65 per cent.

In evidence of this, further samples of castings in the mixtures just mentioned were annealed for 96 hours at 950 degrees Cent., after a heating period of 40 hours, and slowly cooled. Analyses of these samples are given in the following table:

	10 Per cent	11 Per cent
Total carbon	2.86	2.55
Comb. carbon	1.23	0.79
Graphite	1.63	1.76
Silicon	0.63	1.09
Sulphur	0.25	0.22
Phosphorus	0.08	0.07
Manganese	0.25	0.29

You will observe both now contain large percentages of free carbon, namely 1.63 and 1.76 per cent, against 0.15 and 0.45 per cent after the short anneal. Both were well annealed, soft, and easily machinable. One peculiar fact is noticeable, and this has occurred in other experiments of the same nature. In the ordinary mixture (containing no steel) the total carbon was practically the same after the short anneal and the long anneal, 2.83 and 2.86 per cent respectively. In the steel mixture there is a considerable diminution of total carbon in the long anneal, viz, 2.55 per cent against 2.96 per cent in the short anneal.

The analyses of samples used in an experiment in which the variable was the packing medium follow:

	12 Per cent	13 Per cent	14 Per cent	15 Per cent
Total carbon	1.83	2.30	2.40	2.30
Comb carbon	0.83	1.00	1.22	1.09
Graphite	1.00	1.30	1.18	1.21
Silicon	0.64	0.60	0.58	0.61
Sulphur	0.32	0.32	0.32	0.33
Phosphorus	0.10	0.07	0.08	0.10
Manganese	0.15	0.15	0.15	0.17

All samples were cast from the same shank of metal, annealed for 120 hours at 950 degrees Cent. after a heating up period of 38 hours. No. 12 was packed in a mixture of six parts of black ore to one part of red; No. 13 was packed in coarse coke dust; No. 14 was packed in black sand from the foundry floor; and No. 15 in two parts of black sand to which had been added one part of fine red annealing ore. All these samples came out clean and free from scale or adhering packing, with the exception of No. 15, the packing of which had caked slightly, but came away clearly from the casting. No. 12 was undoubtedly the best malleable, and most easily machinable, but little fault could be found with the others, No. 14 being, if anything, the hardest. The total carbon in the material as cast, was 3.3 per cent, so that all suffered an elimination of carbon, but none so great as that packed in the standard ore mixture.

During the ordinary run of foundry work it happens usually that the molders are several days in front of the annealing ovens, and castings are cleaned and stacked in the yard awaiting packing. In wet weather these castings are liable to rust, and it occurred to the writer to determine if rust had any effect on the annealing. A number of samples were cast, and divided into three lots. One lot was brushed clean with a wire brush; another lot sand blasted; and the third lot, after sandblasting, left in a damp place until quite rusty. These all were packed in the same pan, and annealed for 91 hours at 950 degrees Cent. Results are given in the following table:

	16 Per cent	17 Per cent	18 Per cent
Total carbon	2.20	2.28	2.21
Comb. carbon	0.62	0.61	1.10
Graphite	1.58	1.67	1.11
Silicon	0.94	0.93	0.94
Sulphur	0.28	0.27	0.29
Phosphorus	0.06	0.06	0.07
Manganese	0.16	0.16	0.16
Brinell	157	153	162

Sample No. 16 was brushed, No. 17 sandblasted, and No. 18 rusted after sandblasting. The sandblasted casting, No. 17, was the softest and most easily machinable. It also contains the highest total carbon and free carbon. The rusty casting shows the lowest free carbon, and the highest combined carbon. These results were so peculiar

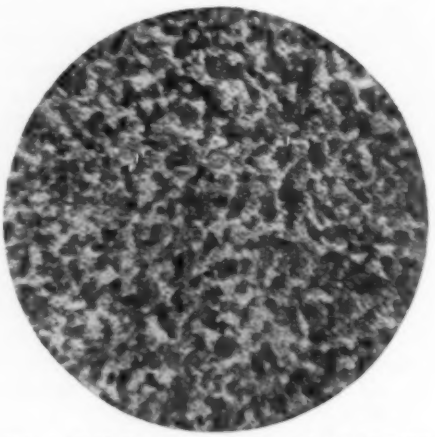


FIG. 2—SAMPLE B HAS SLIGHT TRACES OF FREE CARBON BUT IN SMALL POINTS—X 75 DIA.

that they were repeated several times. A further batch is shown in the following table, in which Sample No. 19 was brushed, No. 20 sandblasted, and No. 21 rusted after sandblasting:

	19 Per cent	20 Per cent	21 Per cent
Total carbon	1.82	2.20	1.87
Comb. carbon	1.31	0.60	1.14
Graphite	0.51	1.60	0.73
Silicon	0.63	0.61	0.60
Sulphur	0.26	0.28	0.28
Phosphorus	0.06	0.06	0.07
Manganese	0.15	0.15	0.14
Brinell	207	196	202

The annealing was varied somewhat in this experiment, being over a period of 61 hours at 950 degrees Cent., followed by several hours slow cooling to 800 degrees Cent., after which the furnace was reheated to 950 degrees

Results of Tensile Tests on Low-Silicon Irons

Sample. No.	Yield point Pounds per sq. in.	Max. stress Pounds per sq. in.	Elongation Per cent on 1½"
22	40,185	61,465	4.5
	41,395	67,693	5.0
23	40,476	60,032	4.5
	45,270	65,587	3.5
24	42,380	58,240	4.5
	45,293	55,462	4.5

Cent., and maintained at that temperature for a further 71 hours. Here again you will notice that the sand-blasted casting, No. 20, contains the highest total carbon and free carbon; but in this experiment, the brushed casting, No. 19, contains the lowest free carbon and the highest combined carbon. It appears from this that castings cannot be too clean at time of packing, and the best results are obtained where it is possible to use the sandblast.

During certain periods, we were much troubled with accumulations of low silicon pig, (0.4 to 0.5 per cent), and the fact that we had little or no malleable pig of higher silicon to mix with it. In consequence, some difficulty was experienced in annealing. In our yard there was a fairly large quantity of an East Coast hematite pig,

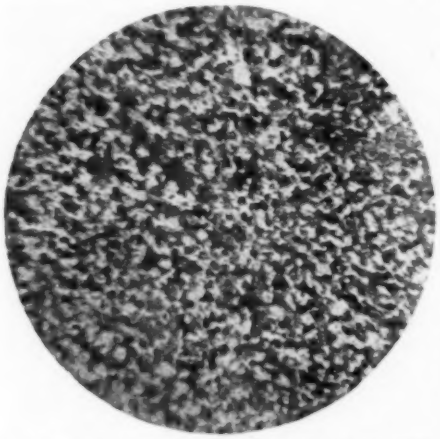


FIG. 3—SAMPLE C IS PEARLITIC AND SHOWS FREE CARBON EVENLY DISTRIBUTED—X 75 DIA.

averaging about 3.7 per cent silicon. Varying quantities of this was mixed with the white pig, and samples and test-bars cast. The analyses of these samples, No. 22 with 10 per cent hematite added, No. 23 with 7½ per cent, and No. 24 with 6¼ per cent, follow:

	22 Per cent	23 Per cent	24 Per cent
Total carbon	2.60	2.26	2.12
Comb. carbon	0.60	0.88	0.84
Graphite	2.00	1.38	1.28
Silicon	1.05	0.70	0.61
Sulphur	0.30	0.26	0.28
Phosphorus	0.16	0.16	0.07
Manganese	0.19	0.09	0.13

All these mixtures were melted in the cupola, and the various samples then annealed together in the same pan. All gave remarkably good specimens of malleable iron, of good mechanical properties. Results of tensile tests are given in the accompanying Table I. From this you will readily see that no fault could be found with these mixtures. We have made many tons of malleable castings, from the mixture containing 7½ per cent hematite.

I now wish to give details of a series of experiments. For this particular series, four types of test castings were made, all of them being 1 x 1½ inches, but of different thicknesses. No. 1 casting was ¼-inch thick, No. 2 was ½-inch thick, No. 3 was ¾-inch thick, and No. 4, 1-inch thick. A large number of each of these were made, care being taken to ensure all being cast from the same shank. Three batches, each consisting of one casting of each thickness, were made up in annealing pans, each batch being in a separate pan. These batches I have called *A*, *B* and *C*, and the individual castings numbered 1 to 4. The oven containing the first three batches was lighted, and raised to 950 degrees Cent. The temperature was maintained at this point with as little variation as possible for 72 hours, when batch *A* was removed, allowed to cool fairly rapidly, but the castings not removed from the pan until quite cold. The furnace temperature was then reduced very gradually during 18 hours, until it reached 800 degrees Cent. Batch *B* was then removed and treated the same as *A*. The furnace was then cooled off to 600 degrees Cent. during four hours, when the heat was shut off, and batch *C* left in the furnace until quite cold. Consider the resultant castings. The analyses of batch *A* follow:

BATCH A

	A1 Per cent	A2 Per cent	A3 Per cent	A4 Per cent
Total carbon	2.77	2.08	2.84	2.18
Comb. carbon	2.73	2.02	2.78	2.10
Graphite	0.04	0.06	0.06	0.08
Silicon	0.68	0.68	0.69	0.70
Sulphur	0.26	0.26	0.24	0.25
Phosphorus	0.05	0.05	0.05	0.05
Manganese	0.14	0.13	0.14	0.14
Brinell	262	255	241	302

As you may imagine, all of these were hard, but several curious points arise. No. 1, which was ¼-inch thick, does not lose nearly so much total carbon as No. 4, which was 1-inch thick, yet No. 2, which was ½-inch thick, loses much more than the ¾-inch sample No. 3. The amount of free carbon is practically the same in each one. I have included the Brinell number, although I came to the conclusion long ago, that the Brinell is no use on castings. Strange to say, the sample which shows the lowest Brinell, and should be the softest, contains the highest percentage of combined carbon.

Passing on to batch *B*, the analyses for which follow, much the same results are shown.

BATCH B

	B1 Per cent	B2 Per cent	B3 Per cent	B4 Per cent
Total carbon	1.44	2.48	2.68	2.62
Comb. carbon	1.37	2.40	2.57	2.42
Graphite	0.07	0.08	0.11	0.20
Silicon	0.70	0.73	0.74	0.74
Sulphur	0.26	0.25	0.25	0.25
Phosphorus	0.06	0.05	0.06	0.06
Manganese	0.12	0.13	0.13	0.14
Brinell	228	228	212	255

The free carbon is slightly higher, and here again, the lowest Brinell is recorded by the sample having the highest percentage of combined carbon. No. 1 is rather peculiar in showing a low total carbon, much lower than any in the preceding analyses.

The results of analysis of batch *C* are as follows:

BATCH C

	C1 Per cent	C2 Per cent	C3 Per cent	C4 Per cent
Total carbon	2.44	2.62	2.66	2.38
Comb. carbon	2.38	2.54	2.60	2.28
Graphite	0.06	0.08	0.06	0.10
Silicon	0.68	0.70	0.70	0.68
Sulphur	0.23	0.23	0.23	0.23
Phosphorus	0.08	0.07	0.07	0.08
Manganese	0.12	0.13	0.13	0.13
Brinell	241	228	241	255

These figures are similar to those we have just seen. All the samples in each batch were hard, and difficult to machine. This is only to be expected from the short heat treatment.

Further batches of samples from the same cast were taken as before, packed in the same strength of ore, and placed

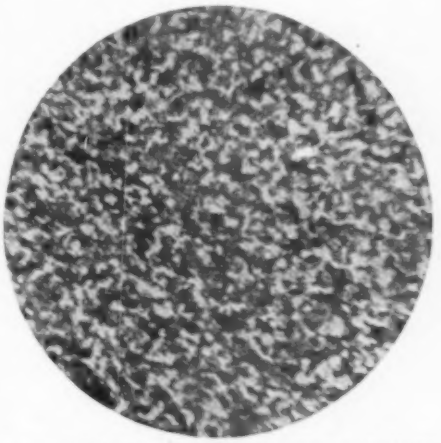


FIG. 4—SAMPLE D SHOWS CEMENTITE BROKEN DOWN AND APPEARS SIMILAR TO B—X 75 DIA.

in the annealing furnace. These batches I have called *D*, *E* and *F*. The furnace was raised to 950 degrees Cent., and instead of maintaining steadily at this temperature for 72 hours as in the previous experiment, it was kept at this temperature for 18 hours, then cooled to about 850 degrees Cent., and allowed to remain at or below this temperature for six hours. The temperature was then raised again to 950 degrees Cent., kept at this for another 18 hours, and the cooling process repeated. This treatment was carried out for a third time, giving a total heat treatment of 72 hours, out of which 54 hours were at 900 degrees to 950 degrees Cent. and 18 hours below 900 degrees Cent., when batch *D* was removed and cooled as in previous test. The furnace temperature was then dropped slowly to 800 degrees Cent. during 18 hours, and batch *E* removed. The furnace was cooled down to 600 degrees Cent. in four hours, when the heat was cut off, batch *F* being left in the furnace until cold. In these two series of experiments, the batches which should be

strictly comparable are *A* and *D*, *B* and *E*, *C* and *F*, as each of these pairs have had the same length of treatment.

Analyses of batch *D* are given as follows:

BATCH D

	D1	D2	D3	D4
	Per cent	Per cent	Per cent	Per cent
Total carbon	1.56	2.50	2.07	2.81
Comb. carbon	1.48	2.44	1.97	2.73
Graphite	0.08	0.06	0.10	0.08
Silicon	0.75	0.75	0.75	0.73
Sulphur	0.24	0.25	0.24	0.24
Phosphorus	0.07	0.07	0.06	0.06
Manganese	0.12	0.12	0.13	0.12
Brinell	202	255	228	241

All the castings were hard and difficult to drill. The loss of total carbon does not appear to be influenced by size, as No. 3 loses much more than No. 2. These figures are similar to those shown for batch *A*.

Details of batch *E* are given as follows:

BATCH E

	E1	E2	E3	E4
	Per cent	Per cent	Per cent	Per cent
Total carbon	1.67	1.71	2.04	2.54
Comb. carbon	1.29	0.71	1.01	1.22
Graphite	0.38	1.00	1.03	1.32
Silicon	0.70	0.70	0.70	0.70
Sulphur	0.22	0.22	0.22	0.22
Phosphorus	0.08	0.09	0.08	0.08
Manganese	0.14	0.14	0.13	0.14
Brinell	202	207	202	207

These castings were much softer than batch *D*, and as you will see, contain quite appreciable quantities of free carbon. The results differ materially from those given for batch *B*.

The results on batch *F* are as follows:

BATCH F

	F1	F2	F3	F4
	Per cent	Per cent	Per cent	Per cent
Total carbon	2.46	1.99	2.58	2.72
Comb. carbon	1.20	1.11	1.35	1.43
Graphite	1.26	0.88	1.23	1.29
Silicon	0.70	0.70	0.70	0.68
Sulphur	0.23	0.23	0.23	0.23
Phosphorus	0.09	0.08	0.08	0.08
Manganese	0.11	0.11	0.12	0.13
Brinell	163	196	187	196

All these samples were reasonably soft, and machined freely. Again there are considerable percentages of free carbon; also further evidence that elimination of carbon does not appear to be governed by size.

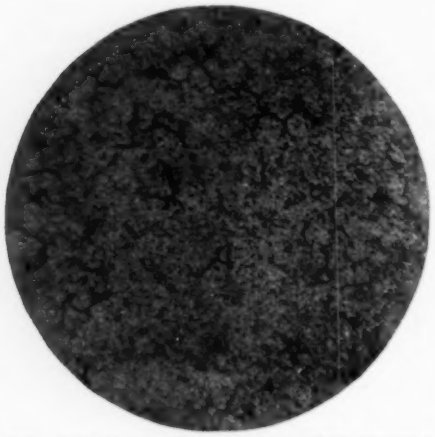


FIG. 5—SAMPLE E INDICATES CONSIDERABLE FREE CARBON PRESENT—X 75 DIA.

None of the samples was a perfect specimen of malleable iron, owing to the shortness of the heat treatment given. As batches *C* and *F* are strictly comparable, I have put them side by side for convenience as follows:

Comparing Batches C and F

	C3	F3	C4	F4
	Per cent	Per cent	Per cent	Per cent
Total carbon	2.66	2.58	2.38	2.72
Comb. carbon	2.60	1.35	2.28	1.43
Graphite	0.06	1.23	0.10	1.29
Silicon	0.70	0.70	0.68	0.68
Sulphur	0.23	0.23	0.23	0.23
Phosphorus	0.07	0.08	0.08	0.08
Manganese	0.13	0.12	0.13	0.13
Brinell	241	187	255	196

Notice the marked difference in free carbon between *C3* and *F3*, also between

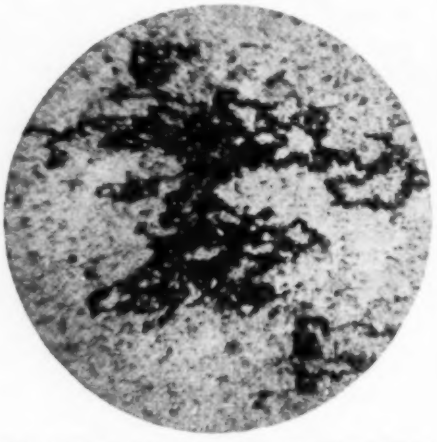


FIG. 6—SAMPLE F SHOWS AREA OF FERRITE WITH SEGREGATIONS OF FREE CARBON—X 75 DIA.

C4 and *F4*. It would appear from this, and also from many other experiments on the same lines, that it is not desirable to maintain a rigid temperature during annealing, nor to vary only within narrow limits. Lowering temperature at certain times during the process of annealing seems to favor the decomposition of carbide, and the liberation of free carbon. I should like to emphasize one other point arising from these experiments and that is the necessity for slow cooling. Evidence of this is supplied by the differences in composition of batches *D* and *F*, and I have had many other instances. Many annealers pull down the front wall of an oven as soon as the last fire has burned off, and expose the pans to cold air while they are at a bright red heat. In my opinion this will undo a great deal of the good done during the annealing process. I prefer to leave the front wall or door up, until the pans have cooled to a black heat. Time spent in cooling down slowly is not time wasted.

Before concluding, I will give a brief survey of the micro-structure of representative samples from each batch.

Samples have been polished, etched with picric acid, and examined under the microscope.

Sample *A*, Fig. 1, shows a cementite structure, but differing from that of white iron, and no free carbon is apparent.

Sample B, Fig. 2, shows slight traces of free carbon, but in small points rather than in aggregates; the structure is mainly pearlite, but cementite still is evident.

Sample *C*, Fig. 3, Free carbon is more evident, yet still appears to be distributed evenly. The structure is mainly pearlitic.

Sample *D* is shown in Fig. 4. This is quite different from *A*, the cementite having broken down, and the structure being chiefly composed of pearlite. This sample approximates more to the structure of sample *B*.

Sample *E*, Fig. 5, shows considerable free carbon present, especially near the surface, but evenly distributed either in small pin-points or nodules, or else in fine lines. This section also shows a skin of ferrite which shades off into an area of pearlitle, containing traces of cementite.

Sample *F*, Fig. 6, shows a considerable area of ferrite with patches or segregations of free carbon. This ferrite extends to some depth; toward the center the structure changes into pearlite and cementite.

Foundry Supply Company Is Organized

The Steel Mill & Foundry Supply Co., San Francisco, with branch offices and yards at South San Francisco, Oakland and Los Angeles, recently was organized to deal in scrap iron and steel, pig iron, coke, ferroalloys and refractories for rolling mill and foundry use. I. L. Ward, former purchasing agent for the Pacific Electric railroad and a number of other companies, is general manager of the new company, and W. A. Letcher, former vice president of the Northwestern Sheet & Metal Products Co., Inc., Seattle, is secretary and treasurer. Directors are: C. P. Burgess, Pacific Coast Steel Co., San Francisco; W. L. Booth, Judson Mfg. Co., San Francisco; D. H. Botchford, Columbia Steel Co., San Francisco; Reese Llewellyn, Llewellyn Iron Works, Los Angeles, and A. C. Denman Jr., South California Iron & Steel Co., Los Angeles.

Acquires Crane Business

The Toledo Crane Co., Bucyrus, O., recently has acquired the crane business of the Toledo Bridge & Crane Co., Toledo, and with it the patterns, drawings and records of all cranes built during the past 11 years by the latter company. Repair or replacement parts or duplicate cranes will be supplied by the new organization.

Weightman & Steigely, 406-21 North La Salle street, Chicago, desire catalogs of foundry and industrial equipment.

Melts Gray Iron With Natural Gas

Casting Company Discovered That Iron Could Be Melted in the Same Type of Furnace as They Were Using for Brass Melting—Oil Used for Fuel When Gas Can Not Be Secured

LACK of an efficient means for melting small amounts of gray iron has kept many firms from establishing their own foundries. How this problem has been solved by the Homestead Valve Mfg. Co., Pittsburgh, will be of interest especially as this company has succeeded in melting gray iron with natural gas without regenerating either the gas or the air.

CHEAP melting requirements are met for the great majority of gray-iron foundries by the cupola, and this melting medium also produces a satisfactory grade of metal for nearly all classes of work. However, there are occasional exceptions both as to quality and cost. In some cases the air furnace is substituted for the cupola to produce an iron lower in carbon and sulphur than can be secured from the cupola as well as to give a large body of hot uniform metal. More recently the electric furnace has been introduced into a few gray-iron foundries to produce a superheated metal low in sulphur and comparatively free from oxidation and slag inclusions. Both of these processes produce a metal of high quality but have some disadvantages for the foundry which wants a high quality and has only a limited output. The air furnace has not established itself to any great extent in units much below 10 tons capacity, while for melting only a few ton a day, the electric furnace would be rather expensive, both as to operating and first cost of installation. Expense of melting small heats also is increased in the cupola as just as much coke is required on the bed, whether one or 20 charges are melted and the expense of preparing it for the heat is the same in both such cases.

These points are considered by the Homestead Valve Mfg. Co., Homestead, Pa., which is melting 1 to 3 tons of gray iron a day for valve castings which require a close grained metal that will withstand high hydraulic pressure. Fifteen years ago the company started to make brass castings in a Schwartz furnace made by the Hawley Down Draft Furnace Co., Easton, Pa. Later a second furnace of the same size was installed and occasional heats of semisteel were made. The quality of the semisteel produced was so good that the company decided to install two 1-ton furnaces of the same type for melting iron and semisteel. With the installation of these furnaces the company began to make all of its own ferrous as well as nonferrous castings.

All four furnaces now are located in a new furnace house built at an angle between the two molding departments. A view of the furnace room may be seen in Fig. 1, which shows the two 1-ton furnaces in the foreground. The two smaller furnaces are almost directly behind the large

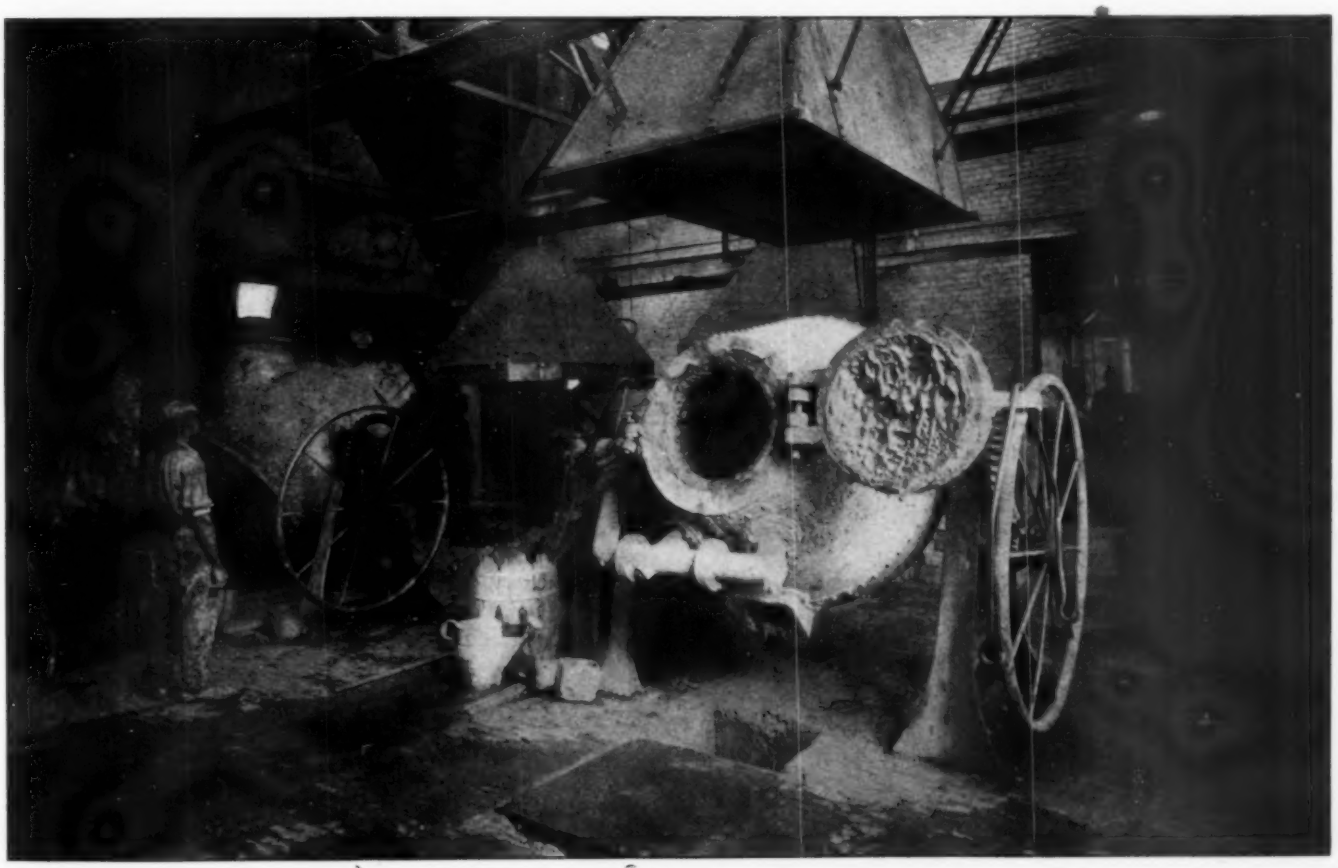


FIG. 1—THE TWO 1-TON FURNACES USED FOR MELTING IRON STAND IN FRONT OF THE BRASS FURNACES—ONLY ONE OF EACH KIND OF FURNACE IS USED ON THE SAME DAY

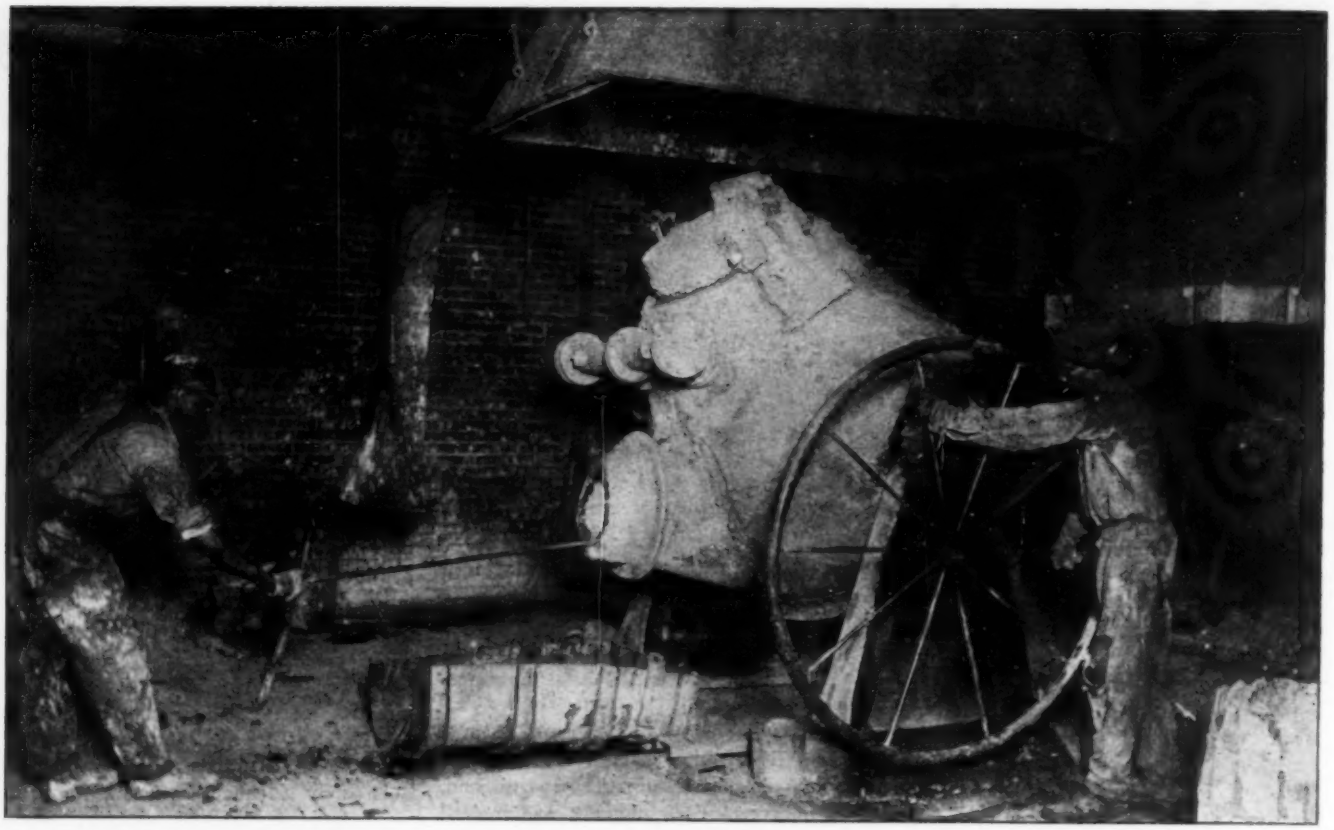


FIG. 2—SLAG IS PULLED OFF THE CHARGE WHEN IT IS NEARLY HOT ENOUGH TO POUR AND THE BLAST IS THEN PUT ON FOR 10 MINUTES LONGER TO SUPERHEAT THE METAL—THE FURNACE IS TILTED WITH A LARGE HAND WHEEL

ones. Only one furnace of each size is used on any one day. The furnace to the left is melting a heat of iron and the flames are directed upward and pass out the stack above the furnace. The furnace to the right shows the charging door open. Large hand wheels geared to the furnaces are used for tilting them.

When the furnaces first were installed, fuel oil was used as a melting medium, but about five years ago natural gas was tried and found to give satisfactory results after the tuyeres had been slightly modified. Now natural gas is used when it can be had in sufficient volume, otherwise the furnaces are heated with oil. Some days only one heat is made while as many as three heats are cast on other days. Of course more fuel is required per ton when only one heat is melted in a day. This is illustrated by the records for two days. On the first day, one heat of 1911 pounds was melted with 11,000 cubic feet of gas, or at the rate of 11,513 cubic feet of gas per ton of metal. The second day three heats totaling 6430 pounds of iron were melted with 20,700 cubic feet of gas, which is at the rate of 6438 cubic feet of gas per ton of metal. Records of the use of oil over an extended period when from one to three heats were melted per day show that 40,034 pounds of iron were melted with 1860 gallons of oil. This indicates that approximately 93 gallons of oil were required to melt a ton of iron. However, had the furnace been worked to its capacity, and three heats been taken off each day this figure would have been reduced materially. Blast is furnished by a blower manufactured by the P. H. & F. M. Roots Co., Connersville, Ind.

The charge usually consists of 50 per cent pig iron, 40 per cent gray-iron scrap and 10 per cent steel scrap. It has been found that sand does not injure the furnace and so no effort is made to secure machine-cast pig iron, nor are the sprues cleaned before being charged into the furnace. From 2¼ to 2½ hours are required for the heat. Just before it is ready to pour the slag is skimmed off into a steel skip as shown in Fig. 2, then the blast is put on for 10 minutes. Coming in direct contact with the metal as it does after the slag is removed, the flame soon heats the metal to a temperature for pouring. Here, too, is a point which must be watched while operating this furnace, for if the flame is oxidizing a large percentage of the iron will be oxidized and if there is a large excess of gas the flame will not be of sufficiently high temperature to make the metal hot enough. However, experience has taught the melter how to keep the flame neutral, and the loss of metal, including the sand adhering to the pig iron and scrap is only 4 per cent, or not more than is lost in the cupola.

Melting conditions also favor low sulphur because the natural gas fuel does not contain appreciable amounts of this element and the tendency is to remove a slight amount of sulphur rather than to gain it. This keeps down the amount of sulphur in the metal which sometimes is as low as 0.025 per cent. Variation in the flame will modify the oxidizing effects during the melt but this can be avoided by a skilled melter. Approximately 0.30 per cent of silicon and the same amount of manganese are lost, while the total carbon is reduced 0.20 to 0.40 per cent.

The analysis of the pig iron reported by the furnace is checked by the company so that a uniform product can be secured from the furnace. The finished metal usually contains slightly over 2 per cent silicon; between 0.03 and 0.05 per cent sulphur; 0.30 per cent phosphorus; 0.80 per cent manganese, and 3.20 per cent carbon. The metal is close grained and will show a tensile strength between 30,000 and 36,000 pounds per square inch. Fig. 4 illustrates the characteristic microstructure of the cast iron made in this process. This sample contained 1.73 per cent silicon, 0.036 per cent sulphur,

0.302 per cent phosphorus, 0.97 per cent manganese, 2.41 per cent graphite, and 3.26 per cent total carbon.

The brass furnaces are operated much the same as the furnaces melting iron, but there are a few minor differences. In the first place a smaller blower is used and one of these is located near each furnace. These blowers are the No. 4 blower manufactured by the Maxon Furnace & Engineering Co., Muncie, Ind., and are equipped with a 1-horsepower motor.

Zinc Added in Furnace

While the furnaces are rated at 500 pounds capacity, seldom less than 600 pounds is melted in a charge and sometimes as much as 1000 pounds is melted at one time. Usually six heats are made each day. It requires 50 minutes to melt the heat, then some time is consumed in pouring and recharging. Red brass of the composition, 85 per cent copper, 5 per cent tin, 5 per cent lead and 5 per cent zinc is usually made The copper, tin and lead are charged at first with a flux. The zinc is added in the furnace with the phosphor-copper when the heat is ready to pour. The flux is either one of the fluxes sold on the market or consists of broken crucibles put in for the slag to cling to and mixed with common salt to flux the alloy. The flux has been found desirable to keep the metal and ladles clean.

After the heat has been on 30 minutes the furnaceman agitates the metal

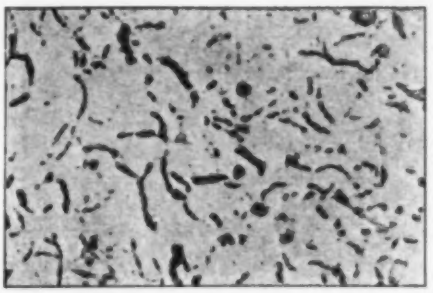


FIG. 4—MICROGRAPH SHOWING THE STRUCTURE OF THE IRON

by rocking the furnace back and forward four or five times every five minutes. This helps to make a more thorough mixture of the metal and to wash the lining, absorbing heat from it. When it is thought that the metal is ready to tap, the temperature is taken with a pyrometer made by the Thwing Instrument Co., Philadelphia. This pyrometer is equipped with a base-metal couple consisting of two wires which are twisted together instead of being fused at the end. About every sixth time the couple is used the ends of the wires which were put into the metal both must be broken off and a new junction made. To provide for this a spool of each kind of wire is furnished with the pyrometer, and the thermocouple lasts until all the wire on the spools is used. The use of the pyrometer has proved beneficial and it has been found that when the temperature of the metal as it comes from the furnace is no lower than 2100 degrees Fahr., nor higher than 2250 degrees Fahr., little trouble is experienced with porous castings.

Melting Loss Low

Fig. 3 shows the melter taking the temperature of the metal before pouring. This temperature is indicated on the instrument shown on the box beside the melter, but is not automatically recorded. However, the melter notes the temperature on the charging sheet and notifies the foreman before tapping so the latter may check the temperature readings made by the furnaceman if he desires. Knowing that his readings are likely to be checked the furnaceman is careful always to record the temperature correctly.

As with melting iron, the melting loss will be excessive if the flame is not regulated properly, but it has been found that this seldom greatly

FIG. 3—THE TEMPERATURE OF THE BRASS IS DETERMINED BY AN INDICATING PYROMETER BEFORE THE HEAT IS TAPPED—WITH THIS METHOD OF HEAT CONTROL THE AMOUNT OF POROUS CASTINGS IS MATERIALLY REDUCED

FIG. 5—BRASS IS POURED INTO MOLDS WHICH ARE CARRIED TO THE POURING STATION ON A REVOLVING TABLE

exceeds 2½ per cent which is the average melting loss. One of the important items of expense in operating these furnaces is the lining. While a lining will last a year in the brass furnace it must be renewed after 75 heats of iron are melted. The furnaces have a bottom made of fireclay and silica sand, and the side walls are lined with a firebrick of a special form. The lining is patched after each heat where needed with fireclay and a high temperature cement furnished by the Quigley Furnace Specialties Co., New York, but it finally gets in such a condition that the entire lining must be taken out and another put in.

Metal is taken from the furnace room on a monorail. Fig. 5 shows a ladle of brass being poured into molds on a revolving table. The monorail may be noted above. Two molders work at this table and the table is revolved so that the molds are all poured at the same station. Another table is in the back of the room. Besides enabling the molds all to be poured at one station, the table allows the molds to be dumped at the same pile without carrying them an excessive distance.

The foundry is equipped with a variety of molding equipment, including two jar squeeze, one strip jar squeeze, one plain squeeze and one jolt squeeze machine.

The sand question has received considerable study by the Homestead Valve Co., and it has been decided that it is economical to secure Albany sand for both the gray-iron and the brass castings. Grade No. 0 is used for the brass and grade No. 1 for the iron. The advantage found in using this sand is that iron poured into molds made with it is not as likely to blow as when the local sands are used. On this account it is not as essential that the molders use care not to ram the molds too hard. While different sands are necessary for brass and iron molds it has been found that a core-sand mixture can be made which will serve for cores for both iron and brass castings. This is an advantage in not requiring the core sand for the two classes of castings to be mixed and kept separate. It also has the added advantage where the same core is used for both gray-iron and brass castings in that it is not necessary to determine whether the core being used has been made from the correct mixture.

The company is well pleased with the furnace house which was designed by them and erected during the summer of 1919. This is a brick building, 35 x 40 feet, with a modified Pond truss forming the roof, the top of which is 21 feet from the ground level. This building with the stacks located over each furnace has a strong draft which keeps it cool in the summer, and in the winter the draft can be cut down by keeping the sash closed.

Issues Book on Blackings

The Bloomsbury Graphite Co., Bloomsbury, N. J., has prepared for complimentary distribution, an excellent treatise on foundry blackings written by Dr. Richard Moldenke. The purpose of blacking materials, their use in the mold and the reaction which produces clean castings from well blacked molds are detailed. The chemical constituents of ideal facing materials are named, and the methods used in their manufacture are dealt with at length. Dr. Moldenke urges a greater degree of co-operation between foundrymen and facing manufacturers to eliminate persistently recurring *skin* troubles in castings.

Appoints Inspectors to Visit Malleable Shops

Four field inspectors recently have been designated by the American Malleable Castings association to aid in the system established to insure uniformity of product from member foundries. These inspectors will travel out from the laboratories of Enrique Touceda, Albany, consulting engineer of the association, calling upon the plants of all of the members at intervals where they will be given free access to the castings on hand and will inspect the product as it comes from the anneal, breaking and testing castings where advisable. These inspectors will report directly to the office of the consulting engineer. When in the plants of members of the association they will exercise a general supervision to insure proper sampling of heats and to afford a close check on the product of each plant.

A method has been devised to govern annealing practice and to eliminate the chance of underannealed castings. Five test wedges are to be placed in each charge annealed. One of these will be placed in the bottom of the stand located in each corner of the oven and the fifth in the center of the oven. In this manner they will be located where the temperature might not reach the high point sought. The five wedges in each anneal will be marked to indicate their location, and wired together to await the inspection of one of the traveling representatives of the laboratories. The inspectors will break the test wedges transversely and examine the fracture for evidences of conditions which should be corrected. These test wedges will supplement the test bars which are made from each air furnace heat and sent to the laboratories for examination.

Addresses Foundrymen on Shop Safety

Frank J. Lanahan, president of the Fort Pitt Malleable Iron Co., Pittsburgh, delivered an address on "Safety Methods in Cupola and Pouring Practice in the Foundry" at the chamber of commerce auditorium, Jan. 24 at the meeting called by the National Safety Council of Western Pennsylvania in connection with its safety first campaign.

Analyze Loss in Aluminum Shops--V

Replies to Questionnaires Give Data Relating to Casting Losses Which Are Summarized in Tables—Kind of Alloys Used, as Well as Composition of Melting Charge Considered

BY ROBERT J. ANDERSON

UPON examining the details of the replies to the questionnaire, considerable data bearing a close relation to casting losses have been found, and it is believed that a detailed production of the greater part of the data contained in the replies will prove useful to aluminum founders in general. Therefore, numerous tabulated forms have been constructed so as to show the relation of the main factors to casting losses. Unfortunately, accurate information as to labor turnover was not available in the majority of foundries and this important item cannot be considered as fully as desired.

The total annual output of aluminum-alloy castings in various individual foundries of the United States ranges from a few hundred pounds, in the case of small shops, up to about thirty million pounds, in the case of the largest company in the business. There are only a few exclusive aluminum foundries in the country, and castings in aluminum-alloys are made in steel and iron foundries, in foundries devoted largely to brass and bronze, and in foundries which produce castings in all kinds of metals and alloys. Probably the only truly exclusive aluminum foundries are those connected with plants manufacturing aluminum cooking utensils, although some of the largest nonferrous foundries operate separate departments and plants devoted solely to aluminum alloys. The replies to the questionnaire together with information from other sources show a total of 81,029,297 pounds of finished aluminum-alloy sand castings made during 1919, and it is estimated that at least 90,000,000 pounds of aluminum alloys are cast annually including plants concerning which no information could be secured, and die-casting companies. From reports received by the bureau and from other sources the 1919 output of die-castings and permanent-mold castings in aluminum alloys is placed at 5,000,000 pounds. The annual output of the largest sand-casting company in the industry is about 30,000,000 pounds. Three foundries reported an annual output of about 10,000,000 pounds; three have an output of between 3,000,000 and 5,000,000 pounds, six foundries produce from between 750,000 and 2,000,000 pounds; and the others ranged lower in production. Foundries having an annual production of 20,000 to 200,000 pounds of finished castings per annum total about fifteen. Numerous foundries and foundry departments of industrial plants reported an annual output of from 100 to 5000 pounds.

Where the attempt is made to determine the relation, if any, between the annual output and the percentage of casting losses many difficulties present themselves, and it is not possible to trace any definite relationship. Generally speaking, the production is rushed in large foundries, and this is conducive to high casting losses. In small plants, the speed of production is rarely so rapid as in large plants, and a slow or moderate rate of production tends toward lower losses. On the other hand, the large plants can afford to employ higher grade men in supervisory capacities, and can engage technical assistance, as well as maintain laboratory control. These factors tend to reduce losses. Table

Table X

Relation of Total Annual Output to Casting Losses

Reply Number	Total annual output in pounds of castings	Kind of castings made	Casting loss, per cent High	Low	Average	Kind of castings which yielded high and low casting losses High loss	Low loss
111	12,000,000	Automotive castings including crankcases, oil pans, manifolds, transmission cases, etc.	20.0	8.0	14.0	Oil pans	Transmission cases
400	9,500,000	Crankcases mainly	14.0	3.0	6.5	Crankcases	Crankcases
594	4,000,000	Automotive castings, all kinds	18.0	3.0	12.0	Manifolds	Bearing holders and caps
523	3,000,000	Automotive castings, all kinds	24.0	3.0	11.0	Manifolds	Foot boards
490	2,205,640	Automotive castings	....	....	3.5	Crankcases	Crank caps
292	1,000,000	Automotive castings, crankcases, housings, oil pans, magneto parts	20.0	4.0	11.0	.....	.....
472	780,000	Vacuum cleaner castings solely	11.0	5.0	8.0	Nozzles	Bag couplings
248	250,000	Kitchen utensils, automotive castings, electrical-tool castings, motor housings	5.0	...	2.0	Automotive castings	Electrical tool castings
497	125,000	Cooking utensils	15.0	4.0	10.0	.....	.....
455	75,000	Pressure cookers	4.0	1.0	3.0	Pressure cookers	Pressure cookers
222	30,000	Pattern castings, ornamental castings	5.0	0.5	2.0	Pattern castings	Ornamental castings
147	23,000	Crankcases, oil pans, inlet headers, fans, pumps, foot boards	25.0	2.0	10.0	Water pumps	Steering-gear cases and foot boards
438	20,500	Miscellaneous repair castings	7.0	1.0	5.0	Light work	Heavy work
343	20,000	Pulleys, electrical tool castings, patterns	6.0	1.0	4.0	Pulleys	Electrical tool castings
475	6,000	Naval work	10.0	0.09	4.0	.....	.....
114	4,300	Machinery parts, surveying instruments, street car fare boxes, few auto castings	75.0	5.0	25.0	Machinery and instrument parts	Street car fare boxes
102	4,000	Automobile steering wheel spiders; shields for wireless; pattern castings	..	2.0	5.0	Shields for wireless	Automotive steering-wheel spiders
461	3,931	Pump parts, automotive, vacuum sweeper, ornamental	26.0	15.0	25.0	Pump parts	Ornamental
498	3,751	Thermometer parts, time clock parts, etc.	23.0	2.0	10.0	Light castings	Castings of uniform thickness
477	2,511	Machinery parts, vacuum cleaner parts	33.0	2.0	9.0	.....	.....
501	1,658	Naval castings; patterns	5.0	0.0	1.25	Small chuncky castings	Castings of uniform shape
333	500	Small parts for navy work	2.0	1.0	1.0	Light open castings	Heavy solid castings

X is a summary of a number of replies, indicating the annual output of the individual plant; the kind of castings made; the high, low and average casting losses; and the kind of castings which yielded the greatest and the least losses. The tendency is toward greater casting losses in the larger foundries, on the basis of the data reported in the questionnaire replies.

The standard No. 12 alloy continues to be the usual allloy employed for aluminum-alloy sand castings. On the basis of the figures reported during the present investigation, out of a total annual output of 81,000,000 pounds of sand castings, 78,897,000 pounds, or 97.40 per cent, were made of No. 12 alloy. Numerous other alloys are used in the United States for sand castings*, but the total output is relatively small. The total output of castings made of various aluminum alloys as reported to the bureau (and from other sources) is given in Table XI. Binary aluminum-zinc alloys are not used to an important extent in the United States now, although they were formerly prominent alloys. They are still favored in England for many purposes, but are gradually being supplanted everywhere by the light aluminum-copper alloys. Ternary aluminum-copper-zinc alloys, of various composition, occupy the second position in total output. Certain of these alloys are desirable for particular purposes such as carburetor bodies. It has not been possible to trace any pronounced relationships between the kind of alloys melted and the castings losses because of incomplete data. High copper in No. 12 alloy is generally considered a cause for cracking in the molds, but this defect can often be traced to other causes.

Table XI

Kinds of Alloys Melted for Sand Castings

Approximate chemical composition	[a]Total output in pounds	Percentage of total output
Binary-aluminum-copper alloys		
No. 12 alloy Al: Cu=92:8	78,897,000[b]	97.403
Al: Cu=98:2	4,000	0.005
Al: Cu=97:3	1,000	0.001
Al: Cu=96:4	225,000	0.278
Al: Cu=94:6	40,000	0.049
Al: Cu=93:7	200,000[b]	0.247
Al: Cu=90:10	200,000[b]	0.247
Binary aluminum-magnesium alloys		
Al Mg=92:8	25,000	0.031
Binary aluminum-zinc alloys		
Al: Zn=90:10	30,000	0.037
Al: Zn=74:26	20,000	0.025
Al: Zn=67:33	100,000	0.123
Ternary aluminum-copper-manganese alloys		
Al: Cu: Mn=98:1:1	15,000	0.019
Ternary aluminum-copper-tin alloys		
Al; Cu; Sn=88:8:4	25,000	0.031
Al: Cu: Sn=85:5:10	12,000	0.015
Ternary aluminum-copper-zinc alloys		
Al: Cu: Zn=90:5:5	20,000	0.025
Al: Cu: Zn=90:8:2	50,000	0.062
Al: Cu: Zn=90:7:3	3,000	0.004
Al: Cu: Zn=87:8:5	5 000	0.006
Al: Cu: Zn=80:7:13	2,000	0.003
Al: Cu: Zn=78:3:19	1,000,000[c]	1.234
Al: Cu: Zn=76:4:20	5,000[c]	0.006
Al: Cu: Zn=73:2:25	1,000	0.001
Al: Cu: Zn=65:3:32	70,000	0.086
Ternary aluminum-manganese-zinc alloys		1427
Al: Mn: Zn=62:1:37	50,000	0.062
Totals	81,000,000	100,000

a. On the basis of data reported and from other sources.
b. The figures for No. 12 alloy, for 93:7 Al:Cu alloy, and for 90:10 Al:Cu alloy, may be subject to some correction because of errors in reporting. Thus the figures for the 93:7 Al:Cu alloy might be included with those for No. 12 alloy, and the figures for No. 12 alloy may include output of 93:7, 90:10, and other alloys richer in copper, such as manifold and piston alloys.
c. Figures for ternary aluminum-copper-zinc alloys also vary markedly from year to year, depending upon the demands of the trade.
Note:—This table is as accurate as the data available permit.

*Anderson, R. J., Special and commercial light aluminum alloys. Bureau of Mines, Minerals Investigations Series, No. 14, April, 1919, pp. 8-19.

Binary Aluminum-Copper Alloys. In foundry practice, the iron content of No. 12 alloy may vary from 0.40 to 2 per cent, and, strictly speaking, this is a ternary aluminum-copper-iron alloy. Some foundries endeavor to maintain the copper content on the low side of the existing specifications*, and their alloy is made so as to contain close to 7 per cent copper, while others endeavor to keep the copper content higher, about 8.5 per cent.

An alloy having 98 per cent aluminum and 2 per cent copper, used for scale trimmings, is employed in limited amounts, and one containing 97 per cent aluminum and 3 per cent copper is adapted in a subordinate amount for patterns and for cooking-utensil castings. An alloy containing 96 per cent aluminum and 4 per cent copper is employed in small amount for pump parts, aircraft castings, radio equipment in electric ship work, for carburetor castings, ignition and starter housings for motor cars and aircraft, match plates, some few crankcases, cooking utensils, vibrator housings, and housings for fractional horsepower electric motors. Another alloy containing 94 per cent aluminum and 6 per cent copper is used to a subordinate extent for aircraft parts, machinery castings and patterns, and in electrical-tool work. The alloy containing 93 per cent aluminum and 7 per cent copper is used in small amount for automotive castings, and as a general casting alloy, being in fact No. 12 alloy low in copper, as previously explained. An alloy containing 90 per cent aluminum and 10 per cent copper has been reported as being used for manifolds, pistons, pressure cookers, and small parts of surveying and scientific instruments such as balance beams, compass boxes, etc.

Binary Aluminum-Magnesium Alloys—The binary aluminum-magnesium alloys were formerly employed fairly widely for castings, but the output has declined in recent years. At the present time, an alloy containing about 92 per cent aluminum and 8 per cent magnesium is used to a slight extent for small castings such as instrument cases, covers for motors and small mechanical parts. Various other binary aluminum-magnesium alloys containing from about 2 to 10 per cent magnesium are used to an unimportant extent.

Binary Aluminum-Zinc Alloys—An alloy containing 90 per cent aluminum and 10 per cent zinc is used to a small extent for motor-car pump parts, ornamental castings, hat blocks, patterns, vacuum-cleaner castings, and miscellaneous motor castings. An al-

*A common specification calls for 7.0-8.5 per cent copper and maximum impurities 1.70 per cent, remainder aluminum.

loy containing 74 per cent aluminum and 25 per cent zinc is reported as being used for pulleys, patterns, electrical tool parts. The aluminum-zinc alloy most commonly employed for castings is the so-called 2:1 alloy, containing about 67 per cent aluminum and 33 per cent zinc. This alloy has been used for practically all kinds of castings.

Ternary Aluminum-Copper-Manganese Alloys—An alloy containing approximately 98 per cent aluminum, 1 per cent copper, and 1 per cent manganese is used to a limited extent at the naval gun factory, Washington, D. C., for some castings employed in ship work but it has also been employed for street-car fittings and instrument parts.

Ternary Aluminum-Copper-Tin Alloys—Alloys of aluminum, copper and tin in varying proportions are more favored in England than in the United States, but two such alloys are reported as being used here for particular purposes. An alloy containing 88 per cent aluminum 8 per cent copper, and 4 per cent tin is used to a small extent for automotive castings such as crankcases, oil pans, inlet heaters, fans, pump parts housings, and foot boards. Another similar alloy containing 85 per cent aluminum, 5 per cent copper, and 10 per cent tin, is used for housings for vibrators and for fractional horsepower motors. Tin is added to aluminum-copper alloys for the purpose of obtaining clean and ductile castings, and with the belief that ternary aluminum-copper-tin alloys are liable to be more free from pin holes than other aluminum alloys. There is apparently some basis for the latter idea.

Ternary Aluminum-Copper-Zinc Alloys—Alloys of aluminum, copper, and zinc are more favored than simple binary aluminum-zinc alloys, and a wide range of compositions are found in commercial practice. The aluminum may vary from about 60 to 90 per cent, the copper from 2 to 10 per cent, and the zinc from 2 to 35 per cent. Obviously, some of these alloys are not suitable for most casting purposes. An alloy containing 90 per cent aluminum, 5 per cent copper, and 5 per cent zinc is used for brackets, vacuum-cleaner parts, patterns, housings, and small miscellaneous castings. An alloy containing 90 per cent aluminum, 8 per cent copper, and 2 per cent zinc has been employed for some automotive castings, and for small machinery parts. An alloy containing 90 per cent aluminum, 7 per cent copper, and 3 per cent zinc is used for naval castings, instrument parts, and match plates. An alloy containing 87 per cent aluminum, 8 per cent copper, and 5 per cent zinc is employed for machinery parts and patterns in small amount, and an alloy containing 80 per cent aluminum, 7 per cent copper and 15 per cent zinc has been used for the same purposes. The so-called 20:3 alloy is the most generally used of the ternary aluminum-copper-zinc alloys. It is exemplified by such compositions as 78 per cent aluminum, 3 per cent copper, and 19 per cent zinc, and 76 per cent aluminum, 4 per cent copper, and 20 per cent zinc. The composition usually aimed for is 77 per cent aluminum, 3 per cent copper, and 20 per cent zinc. This alloy, or similar ones, is used for automotive castings, some aircraft castings, and for general jobbing work. Similarly, the so-called 25:3 alloy, containing 72 per cent aluminum, 3 per cent copper, and 25 per cent zinc is used for some automotive castings, and for general jobbing. A ternary alloy of the 2:1 aluminum-zinc type, is exemplified by an alloy containing 65 per cent aluminum, 3 per cent copper, and 32 per cent zinc. This has been used for scale trimmings and other small castings.

Ternary Aluminum-Manganese-Zinc Alloys—An alloy containing 62 per cent aluminum, 1 per cent manganese, and 37 per cent zinc is reported as being used for small electric-motor housings, printing blocks and motion-picture machine parts.

Complex-Alloys—Only an insignificant amount of castings are made annually in the United States from quaternary and more complex alloys. Thus, a production of 200 pounds of an alloy containing 95 per cent aluminum, 3 per cent copper, 1 per cent magnesium, and 1 per cent manganese is reported as used for machinery parts and instrument work. A complex alloy containing 93 per cent aluminum, 3 per cent copper, 2 per cent nickel, 1 per cent manganese, and 1 per cent iron has been reported, and many complex and senseless alloys are experimented with. * Such alloys are not at all important when referred to the total output of light aluminum-alloy castings. Castings made of so-called aluminum-bronze are increasing in use, but heavy alloys are not considered in these articles.

Table XII

Tendencies in the Composition of Heats of No. 12 Alloy

AVERAGE PERCENTAGE OF MATERIALS CHARGED PER HEAT[a]

Number of pounds per average heat	Primary aluminum ingot	Copper	50:50 Cu: Al alloy	Secondary aluminum ingot	Primary aluminum alloy (No. 12) ingot	Secondary aluminum alloy (No. 12) ingot	Foundry scrap gates, risers and defective casting	Scrap castings from outside sources
4000	33.6	..	6.40	..	..	25	35	..
600	60	..	9.6	..	..	16	14.4	..
400	..	..	..	..	..	50	50	..
250	8	..	8.5	50	..	3.5	30	..
200	50	..	8	..	..	..	30	12
200	..	..	..	..	45	..	35	25
150	..	..	..	..	..	..	20	80
120	33.6	..	6.40	..	..	40	20	..
50	92	8	..	..	..	..	?	..
50	..	..	..	..	100	..	?	..
40	..	..	..	..	..	70	30	..
40	..	8	..	92	..	..	?	..
40	..	..	..	..	..	..	?	100
35	30	..	9.6	30	..	..	30.4	..
35	..	2.5	..	30	..	52.5	15	..
30	44	..	?	..	..	44	12	..

a. Reported as being used in various foundries.

Composition of Melting Charge

Data with regard to the composition of melting charges were requested in the questionnaire. The relationship between the melting stock used for castings and the resultant losses is not at all definite, nor have the replies been clear on this point. However, it is safe to say, in a general way, that the quality of the melting charge does direct-

*Anderson, R. J., Special and commercial light aluminum alloys, U. S. Bureau of Mines, War Minerals Investigations Series No. 14, April, 1919.

Table XIII

Materials Consumed in Aluminum-Alloy Castings in 1919

Material used	pounds	per cent of total
Primary (virgin) aluminum ingot	43,000,000	41.41
Secondary (remelted) aluminum ingot	6,500,000	6.26
Primary aluminum-alloy ingot	2,000,000	1.93
Secondary (remelted) aluminum-alloy ingot	18,000,000	17.33
Foundry scrap, largely No. 12 alloy gates, risers, and defective castings	25,000,000	24.08
Rich alloys *a*; 30: 50 Ci: Al, etc.	8,000,000	7.70
Scrap castings, other than foundry scrap *b*	500,000	.48
Copper, as metallic Cu.	500,000	.48
Zinc	330,000	.32
Tin	2,500	0.002
Magnesium	4,000	.004
Manganese	500	.005
Totals	103,837,000	100.00

a Calculated at 50:50 Cu: Al alloy
b Some scrap castings purchased from outside sources are included in the figures for foundry scrap; thus the entire amount of scrap castings of all kinds plus gates and risers may be placed at about 25.0 per cent.

ly affect the casting losses—the poorer the charge, the higher the losses. In casting No. 12 alloy, the practice in different foundries varies widely as to composition of the charge. Some plants use only primary virgin ingot, plus the necessary rich alloy or copper, and a small amount of foundry scrap composed of gates, risers, and defective castings originating in the plant. Others use part secondary aluminum ingot with the preceding charge. Some plants use primary or secondary No. 12 ingot mainly, while others employ scrap castings purchased from outside sources whenever possible. So far as there is any evidence of standard practice, it is found that numerous large and small foundries use a mixed charge composed of the following materials: Primary aluminum ingot; secondary aluminum-alloy (No. 12) ingot; 50:50 rich alloy (hardener); and foundry scrap originating in the plant and consisting of gates, sprues, risers, and defective castings.

The average percentage of materials charged per heat varies, as stated, but the figures in Table XII show the tendencies in making up heats of No. 12 alloy. Other things being equal, high-scrap content heats are likely to give rise to heavier scrap losses than heats made up with less scrap, but this should not be construed to mean that there is anything inherently wrong with the use of scrap. The trouble arises in using dirty scrap and scrap of unknown composition. In the average foundry it is imperative to remelt all the foundry scrap originating in the production of castings, and heavy melting scrap (gates, risers, and defective castings) is a highly desirable material for melting. One foundryman, at least, claims to be able to tone up inferior aluminum ingot by a proper admixture of No. 12 scrap in the charge, and some foundries prefer to make heats from scrap castings exclusively, provided they can obtain scrap of high quality such as scrap aeroplane-motor castings. The majority of the foundries which have any considerable output, normally use from 20 to 80 per cent of primary aluminum ingot plus other materials, but some foundrymen prefer to use primary No. 12 ingot rather than to make the alloy in the foundry. Moreover, it should be said that the condition of the primary and secondary metal markets will affect the kind of materials used in heats. Purchases of melting stock may be made in anticipation of rising or falling markets under normal conditions, or of materials that may be temporarily obtained cheaply, and the foundry foreman is compelled to melt the material supplied. Plants which operate machine shops for machining aluminum-alloy castings, in addition to the foundry de-

Table XIV

Melting Ratios and Castings Losses in Aluminum Foundries

Reply Number	Total amount of metal melted per annum, in pounds	Total amount of finished castings per annum, in pounds	*a*Indicated annual sprue returns in pounds	*a*Indicated percentage of sprue returns	*b*Melting ratio	*c*Melting loss, pounds	*d*Average casting loss per cent.	Total annual amount of castings scrapped, pounds	*e*Actual sprue return, pounds	*f*Actual percentage of sprue returns
431	84,000	38,000	46,000	54.8	2.21	1,260	10.0	4,222	40,518	48.24
403	400	200	200	50.0	2.00	6.0	0.0	00	194	48.50
407	30,000	15,000	15,000	50.0	2.00	450	4.4	600	13,860	46.20
472	1,440,000	720,000	720,000	50.0	2.00	21,600	8.0	62,609	635,791	44.15
375	3,000	1,500	1,500	50.0	2.00	45.0	4.2	66	1,389	46.30
451	6,516,277	3,286,712	3,229,565	49.1	1.98	97,744	8.0	285,801	2,846,020	43.68
287	70,000	40,000	30,000	42.9	1.75	1,050	4.0	1,667	27,283	38.98
191	200,000	120,000	80,000	40.0	1.67	3,000	10.0	13,333	63,667	31.83
205	10,000	6,000	4,000	40.0	1.67	150	1.0	61	3,789	37.89
438	34,200	20,500	13,700	40.1	1.67	513	5.0	1,079	12,108	35.40
442	3,200	2,000	1,200	37.5	1.60	48	5.0	105	1,047	32.72
475	9,500	6,000	3,500	36.8	1.58	143.0	4.0	250	3,107	32.71
490	3,478,503	2,205,640	1,272,863	36.6	1.58	52,178	3.5	79,997	1,140,688	32.79
111	18,000,000	12,000,000	6,000,000	33.0	1.50	270,000	14.0	1,953,488	3,776,512	20.98
114	6,100	4,300	1,800	29.5	1.42	91.5	25.0	1,433	275.5	4.52
400	12,750,000	9,000,000	3,750,000	29.4	1.42	191,250	6.5	625,668	2,933,082	23.00
222	42,000	30,000	12,000	28.6	1.40	630	2.0	612	10,758	25.61
498	5,000	3,751	1,249	25.0	1.33	75	10.0	417	757	15.14
497	165,000	125,000	40,000	24.2	1.32	2,475	10.0	13,889	23,636	14.32
333	500	400	100	20.0	1.25	7.5	1.0	4	88.5	17.70
293	18,000	15,000	3,000	16.7	1.20	270	3.0	464	2,266	12.59
455	84,000	75,000	9,000	10.7	1.12	1,260	3.0	2,320	5,420	6.45
Totals and averages	42,949,680 1,952,258	27,715,003 1,259,773	15,234,177 692,463	.... 36.1	.... 1.62	644,246 29,284	.... 6.44	3,048,175 138,553	11,542,256 524,648	.... 29.99

a. Includes melting loss and casting loss.
b. On the basis of the figures obtained from the division $\frac{\text{Wt. of metal melted}}{\text{Wt. of finished castings}}$
c. Calculated on the basis of 1.50 per cent loss due to oxidation and shrinkage (this varies necessarily).
d. As reported.
e. Less melting and casting losses.
f. Calculated as in *a*, but deducting melting and casting losses.

partment, may send the borings out on toll to a smelter and have them ingoted. Such plants normally employ varying amounts of secondary No. 12 ingot in the charges. It has been difficult to trace any definite relationship between the composition of heats and the resultant casting losses, but ordinarily melts properly made from primary metals will give rise to less losses on casting than those made from secondary metals.

This statement should not be taken too literally for the reason there are grades of primary melting materials that are less desirable for casting than certain other grades of secondary materials, and the term *secondary* is not used to connote anything inferior to that termed *primary*. On the basis of an output of 81,000,000 pounds of finished aluminum-alloy sand castings produced in 1919, and from figures reported in the replies to the questionnaire and from other sources, the estimated figures in Table XIII show the amounts of the various materials consumed in that year.

The effect of the melting ratio upon casting losses in the production of aluminum-alloy castings is one which is often overlooked. While there may be a pardonable pride in low sprue returns, these are almost always secured at the expense of increasing the casting losses —sprue returns in aluminum founding are high at best. If it is assumed, for simplicity, that the melting ratio is weight of metal melted to weight of finished castings poured (exclusive of gates, runners, and risers), it is possible to show that the casting losses, particularly in aluminum alloys, may readily vary directly with this ratio. No account is taken of dross, oxidation and shrinkage losses, for, under normal melting conditions in a given foundry, those factors remain reasonably constant. Castings made in aluminum alloys are normally gated with wider gates and larger, heavier and higher risers than is the case with brass and bronze, consequently the melting ratio has a tendency to be high. In the replies to the questionnaire, numerous foundries reported from 1.5 to 2 pounds of metal melted for every pound of finished castings produced. This means really that from 0.5 to 1 pound of alloy appeared in the form of sprues, runners, risers and defective castings, and this figure also includes the melting loss due to oxidation and shrinkage. If the metal loss be placed at 1.5 per cent for purpose of calculation, and if the percentage of casting loss be taken as reported, a summary may be drawn up as in Table XIV. The indicated melting ratio for some fifty foundries was 1.6, which means that for every pound of finished casting produced, 1.6 pounds of metal was melted. The indicated melting ratio of the twenty-three foundries listed in Table XIV was 1.62.

How and Why in Brass Founding

By Charles Vickers

Shrinkage Failure in Small Brass Casting

We are sending you a small brass casting that has split into two halves and would appreciate your telling us the cause of this difficulty. The casting is a disk of metal 1½ inches in diameter and 3/16-inch thick, and after being machined it split into two disks, separating just as if some parting material had been put between the halves as in the case of the cope and drag of a mold.

This splitting of castings is a shrinkage phenomena and to prevent its recurrence it will be necessary to alter the gate. The present gate fails to feed the casting, instead it drains liquid metal from the castings; and the casting splits because the drained metal lay as a thin film between the cope and drag half of the casting. It will be observed that one side of the disk is recessed and has a comparatively heavy rib extending across. When this rib is cast in the drag it acts as a sump into which metal that remains liquid longest can drain. Perhaps the rib causes the split by taking the film of liquid metal from the center of the casting, but it is more likely the runner is entirely in the drag and also aids is robbing the casting of metal. The remedy is to put a comparatively heavy runner in the cope. Have it heavy enough to set after the casting, then it will feed the same and there will be no separation. We understand, of course, that all the castings on the present gate do not split; only a proportion split, that sometimes none will split for a considerable period. This is the way such things go as the temperature of the metal, the position of the mold and the manner in which the pouring head is filled, all have a bearing on the trouble. The percentage of sound castings will be materially increased, however, if the gate or runner is changed to conform with the suggestion.

Making Crankcases for Spanish Motors

We would like to obtain formulas for aluminum alloys suitable for casting crank cases, which will not check on thick lugs. We are using an alloy of copper and aluminum consisting of 25 kilograms of French aluminum and 5 kilograms of the hardener, 50 copper, 50 aluminum, but this alloy seems to be brittle and checks necessitating the extensive use of chills. We would also like formulas for core sands suitable for aluminum castings.

The formula for No. 12 aluminum alloy is practically correct, as it figures aluminum 83.33 and hardener 16.67 per cent. This would be slightly over 8 per cent copper, and as there are formulas in use having over 12 per cent copper contained therein, no adverse criticism could be directed to the alloy. If it proves too hard the hardener should be diminished. For instance, if 26 kilograms of aluminum is melted with 4 kilograms of hardener, the alloy would contain a little over 6.50 per cent copper and would be considerably softer. Another alloy that could be used to advantage follows: Make a hardener of zinc, 13 kilograms, thin sheet copper, 3 kilograms; aluminum, 16 kilograms and pour into ingots. The best way to make this hardener is to melt 13 kilograms of aluminum with 6 kilograms of 50-50 hardener and add 13 kilograms of zinc.

To make the aluminum alloy melt together 22 kilograms of ingot aluminum and 8 kilograms of hardener. This will give the following alloy: aluminum, 86.67 per cent; copper, 2.50 per cent; zinc, 10.84 per cent.

For cores the proportions of sharp sand and molding sand can be varied to any extent to get the kind of core wanted. Thus a core that must have strength when green will require more molding sand. The less

molding sand in a core, the better; because the molding sand does not allow the passage of the gases generated with the same freedom as sharp sand. The following is an example of a rosin bonded core. Dry sharp sand 3 kilograms; dry molding sand, 1 kilogram, mix thoroughly add powdered rosin, one part to 20 parts mixed sands, wet to the dampness required with clear water. Bake in an oven hot enough to melt the rosin until it smokes freely. This is a strong core. If wanted more friable use less rosin.

Holding Lead in Solution

We would like to learn the formula for an alloy known as "Ungrain Metal," and also the name of the acid or powder which is used to hold the lead in metals consisting of lead and copper, and used for bearings.

"Ungrain" is a peculiar name for an alloy and is not listed in our files. If called upon to produce such an alloy, however, the following formula would be used. The alloy follows: Copper, 86.50 per cent; tin, 11 per cent; zinc, 2.00 per cent; lead, 0.50 per cent.

To hold lead in solid suspension in copper, many methods are followed which are successful in varying degrees. The flux most generally used is sulphur, and 0.25 per cent should be sufficient. Add half the sulphur to the copper before the lead and half after the lead addition, stir thoroughly and pour hot. If the castings are successful, the heads after solidification will have a glassy slightly greenish colored slag on top.

Usually when this slag is absent it may be concluded the lead has separated from the copper and the castings when shaken out hot will *bleed*. Careful furnace work and a good knowledge of alloying are required to make highly leaded copper alloys successfully.

Eliminating Sponginess from Aluminum

We have been making small castings of aluminum which have proved unsatisfactory as they came porous and spongy, and showed blowholes after being machined. The metal we used was scrap from old crank cases. Any information you may be able to give us will be appreciated.

Perhaps the aluminum has been poured into the molds at an unduly high temperature? This will cause the castings to be filled with small detached holes which when machined get filled with dirt and assume the appearance of black specks. This is caused by pouring the aluminum at too high a temperature. We suggest that particular attention be paid to the mode of melting the aluminum and the crucible be filled with scrap broken so it will not rise above the top. This should be heated until it sinks down, at which stage more cold aluminum is charged and this is continued until sufficient aluminum is in the crucible. The aluminum will be in a rather pasty condition, and the furnace should be allowed to build up heat until the aluminum is thoroughly liquid. At this point it will just show red and will have silvery ripples when the surface is disturbed. If the castings are large in area and 3/16 or under in thickness, it may be necessary to heat the aluminum to a full red in order to run them, but do not heat the aluminum to this point provided the castings are of thicker section. Just previous removing the crucible, add fused zinc chloride to the aluminum, about one ounce to one crucible. Then stir, allowing the fumes to pass up the chimney, remove the crucible and pour the castings. Zinc chloride is the best flux to use in this case.

Preventing Zinc Fumes in Yellow Brass

We are making a number of thin brass plates, surface covered with raised letters and other characters which contain enclosed pockets. The castings must be sharp and have fine details. In order to obtain this result and avoid the breaking away of the sand in the mold, we use a fine, loamy sand which we ram exceptionally hard. The molds are thoroughly dried before pouring. We have difficulty with the zinc fumes catching in the various pockets and as the mold is rammed too hard to allow the fumes to escape through the sand, the result is dull outlines and a lack of detail in the castings. Some years ago we heard there was a chemical which suppresses to a great extent, or entirely prevents these fumes. We would thank you if you could advise us regarding the name of this chemical.

There are two elements which can be used in yellow brass to suppress the fumes; these are aluminum and silicon. The addition of 2 ounces of aluminum per hundred pounds of brass is sufficient to suppress the fumes and give fluidity to the alloy so that it will run with greater ease. The drawback with aluminum is that it causes drossing. This can be avoided to a great extent by so adjusting the gates that no two streams will impinge, either against each other or against the sides of the mold. Silicon has the same effect as aluminum, but it drosses less. Two per cent of silicon-copper should be added in place of ordinary copper. The silicon-copper must be added after the copper is molten, and before the zinc. The drawback to silicon is that it cannot be used when lead is present in the alloy as it forms a silicate with the lead which exists as a whitish dross in the castings. If no lead is present the silicon can be used. If lead is present aluminum must be used. Howecer, if the drossing effect cannot be prevented there is no chemical that can be substituted for aluminum or silicon. In case neither of these can be used it would be advisable to vent the copes with an extremely fine vent wire.

Aluminum Alloy for Piston Castings

We would like to obtain a formula for an aluminum alloy to be used for casting aluminum pistons.

The alloys used for the pistons of internal combustion engines vary considerably Thus a German alloy used for the pistons of a 230-H.P. Benz engine was as follows: Aluminum, 80.12 per cent; zinc, 12.13 per cent; copper, 6.02 per cent; iron, 1.43 per cent; silicon, usual impurity. A British patent for Rolls-Royce engine pistons specifies approximately the following alloy; aluminum, 92.05 per cent; copper, 5.25 per cent; nickel, 0.65 per cent; zinc, 1.20 per cent; antimony, 0.85 per cent. A recent United States patent requires, aluminum, 94 per cent; tin, 1 per cent; copper, 5 per cent. Another patent mentions the following alloy; aluminum, 95.50 per cent; copper, 2.50 per cent magnesium, 1.50 per cent, and tin, 0.50 per cent. A recently analyzed commercial piston alloy contained; copper, 12.20 per cent; magnesium, trace; zinc, none; iron and silicon, usual impurity; and the balance was aluminum. This alloy, therefore, was a 12 per cent copper-aluminum alloy, which is the alloy most generally used in this country. We suggest it be made by melting 78 pounds of commercially *pure* aluminum with 24 pounds of copper-aluminum hardener, containing 50 per cent copper, 50 per cent aluminum.

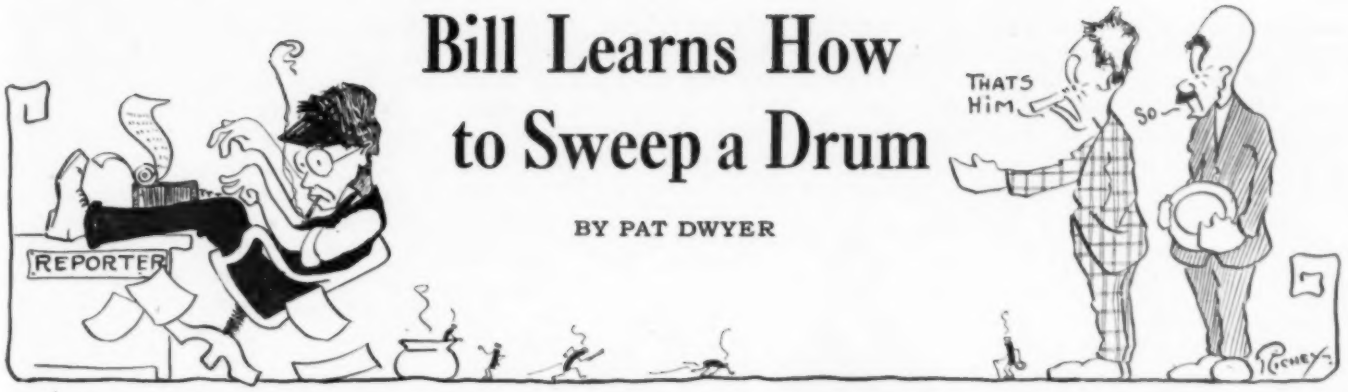
Roll Neck Bearing Metal

We are making roll neck bearings for steel rolling mills and would like to obtain a formula suitable for these castings.

The following alloy is suitable for the castings mentioned: Copper, 79.50 per cent; tin, 8.50 per cent; lead 10.50 per cent, and nickel, 1.50 per cent. An aluminum bronze also gives excellent service; an alloy of approximately copper, 89 per cent; aluminum, 8 per cent, and iron, 3 per cent, should be used.

Bill Learns How to Sweep a Drum

BY PAT DWYER



THE Ancients, which by the way is a happy term to employ when one is not sure of the date, were wont to point with pride to the seven wonders of the world. The inspiration for this exceedingly vulgar habit of pointing very likely was due to the fact that the wonders were contemporary and the ancients assumed to themselves individually and collectively a certain amount of credit for their creation. If any of these masterpieces were made before their time they still pointed to them with pride and would remark casually to any chance acquaintance that their father or their grandfather had helped to fabricate the thing. At any rate, if he actually did not use the hammer and chisel he had drawn the plans and superintended the erection.

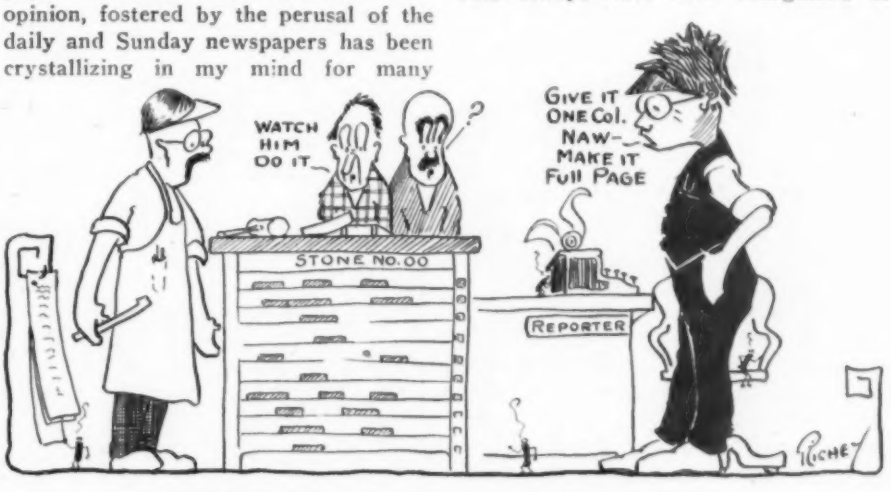
These wonders, no doubt, merited consideration in their day; but if they were placed on exhibition today they probably would be shown in the annex—the side show—the greatest and most stupendous collection of ancient and antidiluvian curiosities, ladies and gentlemen, ever shown under canvas for the small sum of 25 cents a quarter of a dollar; see them now before the big show commences. Under no circumstances can one imagine them competing under the *Big Top* with some of the modern wonders of the world which we view nonchalantly every day and accept as a matter of course. Wonderful to be sure; but, my dear, nothing to get excited over.

Every person has his own opinion on what constitutes the greatest wonder of modern times. On second thought perhaps I should amend that statement to read his own or *her* own opinion since by a recent amendment to the constitution, the loquacious branch of the population has been permitted legally to exercise its opinion. However, speaking offhand and without attempting to go too deeply into the subject we should say that this state of affairs simply is a distinction without a difference. I don't pretend to know any more about the ladies than the next man; but up to the present I never have heard and I don't believe you have either, that the dear creatures ever showed any reluctance in expressing their opinion, irrespective of whether they had legal permission or not.

He may not be at the very top but any person who set about compiling a list of the modern wonders of the world certainly would feel bound to give the newspaper reporter honorable mention. Indeed if it was not for a rule that all such lists should be arranged alphabetically, thus giving the aeronaut the premier position I feel confident that the newspaper man would head the list. This opinion, fostered by the perusal of the daily and Sunday newspapers has been crystallizing in my mind for many years. The reporter goes everywhere, he knows everything, he can write on any and every conceivable subject; but his supreme qualification lies in the fact that he can tell the whole of any story in 10 words if necessary and on the other hand he can stretch the same story over a whole page and then place a note at the bottom to turn to page 4, second column, for the continuation.

He works under pressure at high speed and, therefore, has neither the time nor the inclination to verify his facts. However, he is blessed with a fertile imagination and since the papers are read at the same high speed at which the material is prepared it rarely happens that any of the statements are seriously questioned.

The direct cause leading up to the preparation of this bouquet for the press boys was a despatch I read the other day to the effect that a certain foundry was closed down for the day while the entire office force, armed with .22 caliber rifles, waged a war of extermination on a colony of rats which infested the place. That statement in itself might have passed unchallenged because rats are indigenous to foundries. In fact a peculiar phenomenon confined almost entirely to stove plate shops and known as *rat tails* would seem to indicate that rats always have been recognized as one of the regular appurtenances or appendages of the foundry.



JUST LIKE MAKING A 12-INCH WHEEL FROM A 6-INCH PATTERN

If the reporter had let it go at that and confined himself to the bare statement of facts, no one could object even to the account of the wholesale measures adopted. That was strictly a private affair and if the company had chosen to mount a Gatling gun in the open doorway of the core oven that was its own business. Here is where the reporter's genius manifests itself. In his role of infallible authority and court of last resort he gravely informs us that the reason which precipitated this attack on the rats was because they ate all the cores. It would appear that cores are made of a mixture of

sand and flour in about equal proportions and these particular foundry rats had become so bold and voracious that they simply made a clean sweep of the core racks every night. No mention is made of the core wires; but from the context I think we safely may assume that they followed the sand and the flour.

THEY PICKED THEIR TEETH WITH WIRES FROM THE MOUSE TRAPS

Not content with committing depredations in the core room, where they belonged, some of the rats had become so bold that they went prowling about on the molding floors. With a species of uncanny cunning they selected molds with large risers for the scene of their exploits. A long, skinny, hungry rat experienced no difficulty in slipping down the runner of almost any mold; but the same rat half an hour later with four or five inches of a 6-inch stock core bulging out his vest needed a larger opening through which to make his escape.

The first time I met Bill after I had read the story I asked him what he thought of it and I was pleased to find that his opinion coincided with mine.

"Of course" said he, "it is not to be expected that an outsider should know as much about the intimate details of foundry practice as a man who works in such a place. I am willing to wager (wager is good) a small sum that the general public knows less of the foundry industry than of any other you might care to specify. Beyond the fact that the molder gets himself dirty before the day's work is done and that he *runs* melted iron in some mysterious way into a *cast* the average citizen is blissfully unconscious of the high degree of skill, training, knowledge and judgment possessed by men actively engaged in the manufacture of castings.

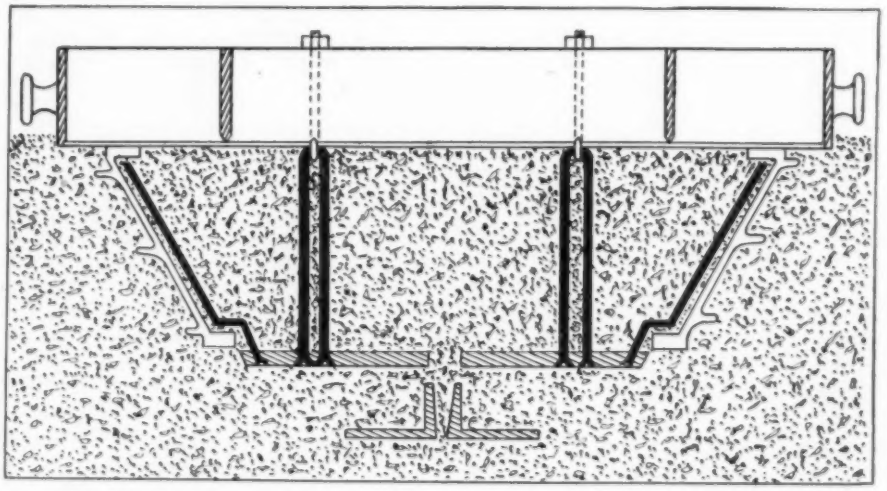
"An impression prevails in some quarters, fostered and encouraged it is true by a cynical minority of the craft, that the only two qualifications needed or possessed by a molder are a strong back and a weak mind. Just to show that I am willing to meet any man half way I am willing to admit the strong back half of the argument; but that is as far as I will go. In the province of purely mechanical and inventive ability and skill I have known molders who did not have to take a back seat from any one.

"I worked at one time for one of these men in a shop where a great deal of coal mining machinery was manufactured. It was an old fashioned shop with a lot of old fashioned molders working in it; but they turned out some mighty nice work. Winding drums of various sizes, some grooved and others plain were made in the usual way. A cheek first was swept and lifted off and after the inside containing the hubs and arms was swept up, the cheek was replaced and the mold made ready for casting. These drums, cylindrical in shape and the same size top and bottom, presented no unusual features; but occasionally an order for a section of drum designed to connect a small drum to a larger one was received. The rig for making these sections especially the part of the rig for cutting the spiral groove around the perimeter of the mold was the most ingenious thing of its kind I have seen in a foundry.

"The job was made in a skin dried mold in the floor. Before commencing to make the mold, an open sand lifting plate 2 inches thick and about 1 inch less in diameter than the lower opening in the casting was made. This plate was provided with 4 lifting loops and a row of ¾-inch rods around the edge.

"Instead of sweeping the top and bottom internal flanges, the patternmaker sawed out a number of flange segments on the band saw. The segments were not joined together but set loosely on the seats made by the sweeps. In addition to the special sweep for making the spiral groove, four other sweeps were prepared. The first sweep was straight on one side and was provided with a jog on the other side corresponding to the inside diameter of the bottom flange. The straight side was used to make a level bed on which to set the segments, after which the sweep was turned over and employed to locate the segments while they were being tucked into place. The wall of the mold was then rammed up approximately to size.

"The second sweep was attached to the sweep arm and the face of the mold swept to correspond to the shape of the inside of the casting; or the inside of the pattern if there had been one including a seat for the lifting plate. The sweep then was removed and old newspapers spread over the surface of the mold after which the lifting plate was lowered into place and the rods adjusted close to the face of the mold. Facing sand containing flour in the pro-



SECTIONAL VIEW OF CLOSED MOLD SHOWING LIFTING PLATE AND COPE IN POSITION

portion of 1 to 20 was laid up against the newspapers, after which the remainder of the space was filled with black sand and rammed up to a point level with the bottom of the top flange. A row of gaggers was set over the top face of the lower flange and a row of rods, increasing in length each time, was laid at each course of ramming.

"The third sweep now was slipped over the spindle and a level bed prepared to make a seat for the upper flange segments which were located in the same manner adopted for setting the lower flange segments. A level parting was made all the way across the top and a cope set on and rammed. Then, the cope was lifted off and left hanging on the crane for a few minutes until the segments forming the top flange were drawn out of the sand. It then was replaced and four hook bolts were dropped through open bars in the cope provided for that purpose. The hooks engaged the loops attached to the lifting plate and after they were screwed up tight the cope was lifted, this time bringing the lifting plate and all the sand forming the inside of the mold with it. The cope was not rolled over; but set on suitable stands and then finished and blacked.

"A fourth sweep, conforming to the shape of the outside of the mold, was next attached to the spindle and a thickness of sand corresponding to the required metal thickness was removed from the face of the mold. At this point the inventive genius of the man of whom I am speaking, came into play. The casting was designed to carry an exterior spiral flange from the top to the bottom in three complete turns. He solved the problem by getting a spiral groove cut in the spindle, the pitch of the screw corresponding to that of the spiral on the drum. Then he had a special sweep arm made with a hole in the hub about an inch larger in diameter than the diameter of the spindle, and having a rectangular horizontal groove machined the full length along one side.

"The arm was lowered over the spindle, carefully centered and leveled and then the space between the wall of the hub and the spindle filled with babbitt. This transformed the hub of the arm into a nut and naturally as the nut traveled around it transmitted a spiral motion to the arm. To compensate for the change in diameter occasioned by the shape of the mold, a sliding arm was attached to the groove in the main arm. The small piece of wood for cutting the groove was attached to the end of the sliding arm. It was provided with a guide or shoulder and the molder simply had to hold this guide against the face of the mold as he went around.

"After the groove had been roughed out by this device it was finished by the aid of a short piece of *mending-up* rib prepared by the patternmaker. The mold was then blacked and dried by a coke-basket fire after which it was closed and poured. Two upright runners, diametrically opposite each other and connected to the bottom flange by means of several small branch gates, were employed to convey the iron into the mold."

"I am not a man" said Bill, "prone to excitement; but whenever I hear this weak head and strong back thing, it gets my goat! I have spent practically all my life in the foundry and I wish to submit that for mechanical ability and technical knowledge the molder is, in the language of Scott's Lord Marmion, 'The peer of any man, lowland or highland, far or near.' "

To which I piously said "Amen."

Plumbago Trade Reaches Low Level

CEYLON plumbago trade reached a minimum in 1919, says United States Consul Robert L. Keiser stationed at Colombo in a report to the department of commerce. Exports dropped from over 33,000 tons in 1916 to 6671 in 1919, he points out. The first five months of 1920, however, show a slight increase in exports, the total for this period amounting to 4235 tons. Of this amount, the United States took 2800 tons or about 70 per cent.

The great slump in exports has led to the closing of the majority of the small mines. During the peak of production (1917) about 1300 mines were in operation, but at the beginning of 1920 less than 50 mines were working. The number of curing yards in Colombo has diminished from 140 to about 30.

The average value a ton of all grades of plumbago exported in 1913 was $110 and in 1917 about $300. In 1918 this figure decreased to about $100; in 1919, to $104; in 1920, to $105.

It is interesting to note that in 1913 the average value of plumbago exported to the United States, United Kingdom, and Germany, the three largest consumers in the order named, was about the same for each of these countries. In 1918 the average value of the plumbago exported to the United States was about $130 per ton, against $80 for the United Kingdom, and a general average of $100.

In 1919 the imports to the United Kingdom averaged $70 per ton, while those to the United States were valued at $130, the general average having been $104. Statistics for the 1920 period show that the average values of exportation to the United Kingdom and the United States are again about the same, or $108 and $113, respectively.

It is estimated that the amount of plumbago available in the Colombo market on Jan. 1, 1920, was approximately 20,000 tons. The present available stocks have probably decreased to 17,000 tons.

With the exception of three companies the mining operations are all in the hands of natives. There is no restriction against foreign companies owning mining properties or carrying on mining operations. The three companies above mentioned are British.

The Ceylon government assesses an ad valorem duty of 3 per cent on all plumbago exported from the island. In former years the island of Ceylon enjoyed practical monopoly of the world's supply of plumbago, but during the last nine or 10 years it has lost this advantage, owing to plumbago having been discovered in large quantities in other countries, especially Madagascar where the export has now reached something like 40,000 tons a year; and it is now a question whether Ceylon will be able to compete in the world's markets.

Organize Company

E. E. Berliner and S. F. McElroy, formerly affiliated with the Michigan Smelting & Refining Co., have organized the firm of Berliner-McElroy & Co., which will engage in the merchandizing of nonferrous metals and compositions. An office has been established at 1111 Superior Viaduct, Cleveland.

A rough rule for figuring oxygen consumption when cutting thin and medium steel is to allow one-fourth cubic foot per square inch of cut surface. Thus a billet 3 inches x 8 inches would require about 6 cubic feet for cutting in two, the area of the cut being 24 square inches.

Meet Steel Castings Specifications

Care Must Be Taken to Have Solid Metal in Test Bar—A Thousand Consecutive Tests Meet Ordinance Departments Specifications—Confidence in Steel Castings Strengthened by Higher Standards

BY E. R. YOUNG

WITH the demand of the last few years for castings of higher physical properties, the makers of steel castings have learned how to meet the new requirements and also have become alive to the desirability of knowing as much as possible about the physical properties of their castings, as well as the methods of testing them. The Detroit Steel Casting Co., along with many other steel foundries, has accumulated some information on the making of castings to specifications.

Work done under the specifications of the ordnance department for Nos. 2 and 3 cast steel, which required a minimum tensile strength of 70,000 and 80,000 pounds per square inch, respectively will be described.

Working to these specifications a record was made of more than 1000 consecutive heats which met the requirements. An analysis of the data on these heats with regard to tensile strength shows that 14 per cent of the total number of heats had a minimum tensile strength of 85,000 pounds per square inch and that 2.4 per cent had a minimum tensile strength of 90.000 pounds per square inch. A more detailed analysis of this data is given in Table I.

Table I

Test Results on 1028 Heats of Converter Steel

Range of tensile strength	No. of heats	Per cent of total	Yield point	Tensile strength	Elongation per cent	Reduction per cent	Carbon per cent	Manganese per cent
90,000 and over..	25	2.4	49,660	93,286	19.78	23.16	.334	.817
85,000-90,000...	120	11.7	47,865	86,865	20.78	26.32	.309	.748
80,000-85,000...	369	35.9	44,909	81,900	22.21	28.57	.298	.720
75,000-80,000...	390	38.0	42,925	77,575	24.02	31.20	.285	.683
70,000-75,000...	124	12.0	41,173	73,505	25.40	34.73	.273	.654

The steel was all made in a side-blow converter and was recarburized with cupola metal. The desired carbon content was 0.28 to 0.33 per cent. The steel was blown to a carbon content of about 0.08 to 0.09, the deoxidizing additions furnished about 0.05 per cent, and cupola metal was added to the extent of about 160 pounds per ton to furnish the remaining 0.16 to 0.18 per cent carbon to meet specifications.

The only unusual point to be mentioned with regard to chemical composition or treatment concerns the use of titanium. It was found that the use of titanium in any form decreased the elongation and reduction and was to be avoided in quantities greater than 1 or 2 pounds per ton, depending on the titanium content of the alloy used.

In making lower carbon steel for miscellaneous castings the practice had been to use about 1 pound of titanium alloy per ton. This amount was increased when beginning this work, with the idea of insuring greater solidity. Trouble in securing proper ductility was encountered and ascribed to various causes, until finally the amount of titanium being used was reduced, whereupon the ductility immediately improved. The data given in Table II show the results of using various quantities of titanium.

The untreated steel was actually superior in physical properties, and titanium was used only as an additional deoxidizer and scavenger, as a precautionary measure.

The annealing was done at a temperature of 1650 degrees Fahr., the castings being held at this temperature for about two hours, and cooled in the furnace. A few heats, in which the carbon and manganese content were both rather low, were aircooled from 1650 degrees Fahr. and reheated at a temperature of about 1300 degrees Fahr. Otherwise there was no variation from a simple annealing treatment.

The tests were made on the usual type of test specimen machined from a bar 1¼ x 1¼ x 8 inches. In cases where the castings were of too small a section to permit of attaching a test bar directly, test bar blocks were used. These blocks were cast in a mold with a casting and gated securely to it. The type of block used was 4 x 6 x 8 inches with two bars at-

Table II

Effect of Various Amounts of Titanium on Physical Properties

Heat No.	Yield point	Tensile strength	Elongation in 2 in. per cent	Reduction of area per cent	Analysis C.	Mn.	Si.	P.	S.	Wt. Titanium Alloy per ton of steel
450	50,000	92,250	24	32	.37	.77	.37	.059	.051	None
A	54,000	90,000	12	12	.38	.77				3¾ lbs. carbon free alloy
B	50,000	92,250	20	23.7	40	.72				7½ lbs. ferro carbon alloy
150	40,000	68,750	32	43	.18	.77	.30	.062	.063	None
A	40,750	57,350	24	27	.18	.77				3¾ lbs. carbon free alloy
B	41,950	74,000	19	20	.20	.73				7½ lbs. ferro carbon alloy
200	41,250	67,250	27	39	.23	.55	.25	.059	.079	None
A	36,500	66,100	22	23	.23	.56				3¾ lbs. carbon free alloy
B	38,500	69,750	26.5	34	.25	.57				7½ lbs. ferro carbon alloy
9	38,150	75,500	28	43.5	.28	.74	.25	.070	.058	None
A	40,500	76,000	28	41.8	.28	.74				¾ lb. carbon free alloy
B	40,000	76,250	27	42	.28	.74				2 lbs. carbon alloy
C	40,200	75,740	27	41.2	.28	.74				1¼ lbs. alumino titanium
1	41,000	66,000	34	57.5	.15	.70	.33	.056	.069	None
A	47,000	67,250	32	50.8	.15	.69				(10 oz. aluminum)
B	45,500	68,900	32	46.9	.15	.70				2 lbs. ferro carbon
8	39,750	64,750	29	47.2	.15	.65	.29	.063	.080	1 lb. carbon free alloy

Paper presented at the annual convention of the American Foundrymen's association, Columbus, O., Oct. 7, 1920, by E. R. Young, Detroit Steel Casting Co., Detroit.

STANDARD SPECIFICATIONS FOR MANGANESE-BRONZE INGOTS FOR SAND CASTINGS

1. These specifications cover the copper-zinc alloy known commercially as manganese-bronze.

I—Manufacture

2. The bronze shall be cast in the form of ingots having notched flat bottoms approximately 3 by 2¾ inches wide by 12 inches long, properly tapered to strip easily from an iron mold.

II—Chemical Properties

3. The bronze shall conform to the following requirements as to chemical composition:

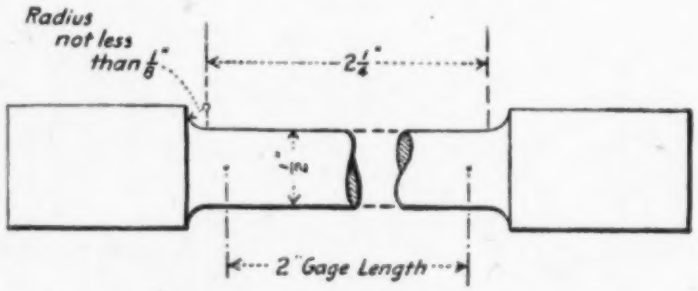
Copper	53 to 62 per cent
Zinc	36 to 54 per cent
Aluminum	0.05 to 0.5 per cent
Lead	not over 0.15 per cent

III—Physical Properties and Tests

4. The bronze shall conform to the following minimum requirements as to tensile properties:

Tensile strength, pounds per square in.	70,000
Elongation in 2 inches, per cent	20

5. (*a*) The tension test specimen shall be cut from one corner near the bottom of the test ingot.



Note:—The Gage Length, Parallel Portions and Fillets shall be as Shown, but the Ends may be of any Form which will Fit the Holders of the Testing Machine.

FIG. 1

(*b*) The specimen shall conform to the dimensions shown in Fig. 1. The ends shall be of a form to fit the holders of the testing machine in such a way that the load shall be axial.

(*Concluded on Data Sheet No. 370*)

Adopted by the American Society for Testing Materials, 1914.

STANDARD SPECIFICATIONS FOR MANGANESE-BRONZE INGOTS FOR SAND CASTINGS

(*Concluded from Data Sheet No. 369*)

6. (*a* One test ingot shall be selected by the inspector to represent 10,000 pounds of ingots or fraction thereof.

(*b*) If any test specimen shows defective machining or develops flaws, it may be discarded, in which case two additional tests may be selected by the inspector from the same lot, and tested to represent the lot.

IV—Marking

7. Each ingot shall be stamped with its proper heat or charge number.

V—Inspection and Rejection

8. (*a*) Inspection may be made at the manufacturer's works where the castings are made, or at the point at which they are received, at the option of the purchaser.

(*b*) If the purchaser elects to have inspection made at the manufacturer's works, the inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturers' works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of cost, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications. All tests and inspection shall be so conducted as not to interfere unnecessarily with the operation of the works.

9. (*a*) If the test ingots selected to represent a lot fail to conform to the requirements specified in Sections 3 or 4, all ingots in such lot will be rejected irrespective of the heat or heats from which the test ingots are selected.

(*b*) Castings which show injurious defects revealed by machining operations subsequent to acceptance may be rejected, and, if rejected, shall be replaced by the manufacturer free of cost to the purchaser. The full weight of the original material rejected shall be returned to the manufacturer.

Note—This sheet may be cut into two sections, 8 x 5 inches, and may be readily bound in note book form.

THE FOUNDRY DATA SHEET, FEBRUARY 15, 1921
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

tached to the lower face. The dimensions of the bars were 1¼ x 1¼ x 8 inches, which gave a bar approximately 1¼ inches square after being removed from the casting or block. The bars were cut from the block by the use of an acetylene torch after annealing with the castings attached.

The fact that the entire series of 1028 heats was within the specifications shows that it is possible to consistently maintain a fixed standard of quality in steel castings. The fact that the converter process was used proves that the method of making the steel is not of first importance in work of this kind, but that satisfactory steel castings with special properties can be made by the converter process, as well as by the open-hearth or the electric process.

To maintain the desired standard and to successfully meet the tests to demonstrate it, it is necessary not only to carefully control the chemical composition and heat treatment, but also to watch the details of preparing the test specimens. The first point to be emphasized is the importance of securing a sound test bar. Specifications are based on the properties of a solid, uniform piece of metal, and the foundryman is only doing himself and his product simple justice when he takes great care to secure this solid, uniform piece of metal. Too often test bars are cast without an individual head or riser, but are merely gated to the casting and f t from one end. There is very little chance of such bars being sound. When it is possible to attach the bars directly to the under side of a heavy section of a casting this is the preferred method, but in other cases a test bar block of ample size to properly feed the bars should be used.

Mold Test Bars

It is desirable to make all test bars and test bar blocks in a mold, and not in a core. If made in a core they are subject to porosity because of the gases evolved from the core, and even though the possible occurrence of this difficulty is entirely obviated by ideal practice, such cores are apt to be kept in stock and to accumulate moisture while standing, and thus cause porous bars.

When made in a mold, and especially when at the bottom of a large mold, care should be taken that the test bar impressions are not partially filled with sand or with mold wash which has drained into them. If attached to a large casting and necked down to aid in breaking off, the neck should not be too narrow or a shrink in the bar will be apt to result.

At the foundry of the Detroit Steel Casting Co. it has been found desirable to eliminate all test bar cores and to use the cutting torch or saw in removing all bars from castings or blocks. When broken off with a sledge there is always the danger of invisible cracks extending into the bar, which do not become evident until the bar is machined or actually pulled. There is no legitimate objection to cutting, on the grounds that the test specimen will be affected by the heat of the cutting operation, as an investigation of this heating effect showed that at the center of the bar where the 0.505-inch machined section would be located, the temperature reached a maximum of 420 degrees Fahr. when the cut was made at a distance of approximately ¾-inch from the center, and a maximum of 290 degrees Fahr. when cut at a distance of 2¼ inches from the center.

When specimens for both a tensile and a bend test are required, it is convenient to increase the depth of bar itself to 3 inches, and cut in two lengthwise, using the lower part for the tensile test and the upper part for the bending test. This method was used successfully on considerable work done under navy specifications.

When it is necessary to cut a section out of a casting to be used as a test specimen, the section chosen should run horizontally in the casting as originally located in the mold, and not vertically. If the section chosen is a vertical one shrinkage is almost certain to appear in the center of the specimen, after testing. This choosing of the specimen is entirely legitimate, as shrinkage is certain to occur in the center of some of the heavier sections of a casting, and allowance is made for it in good design, but the properties required of the test specimen are those of solid metal.

In support of this last statement the case of some tests on draw bar yokes may be cited on which the total strength of the castings themselves was specified as well as the properties of the steel. Specimens taken vertically were unsatisfactory when tested. Those taken horizontally were satisfactory and the total strength of the yokes when tested was above that specified.

A final point that might be made on the desirability of sound and representative test specimens is the minimizing of retests which are bound to create an unfavorable impression on the representative of the purchaser, even when the retest is entirely allowable.

It is well before leaving a discussion of specifications and methods of meeting them to emphasize the fact that specifications and tests only determine the quality of the steel and not the quality of the castings themselves. It is generally admitted that good foundry practice is much more important than slight variations in chemical composition or physical properties, and that it is much more of a guarantee of satisfactory quality. It is true, too, that more difficulties are encountered in the foundry in establishing good practice than in meeting specifications. One reason is that most castings are made under specifications for low-carbon steel, which are easily met. But until there is a greater general confidence among engineers and metallurgists in steel castings as such, the demand for castings of higher physical properties and especially for heat-treated castings will continue to be limited. The confidence of designers in steel castings has been strengthened by the higher standards of quality now prevailing in the steel foundry compared to those of some years ago, and its still further upbuilding by continued improvements in foundry practice should receive the most painstaking attention of the casting industry.

Norton Co. Holds Election

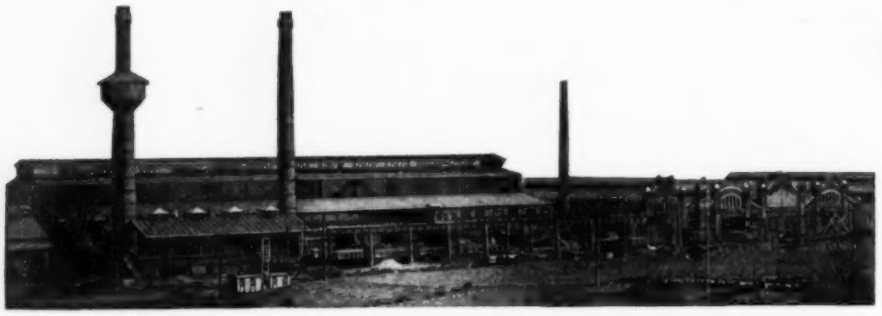
The Norton Co., Worcester, Mass., held its annual meeting Jan. 18, and elected the following officers: Chairman of the board of directors, George I. Alden; president and general manager, Charles L. Allen; vice presidents, Carl F. Dietz and W. LaCoste Neilson; treasurer, Aldus C. Higgins; secretary and works manager, George N. Jeppson; assistant secretary, Clifford S. Anderson; assistant treasurers, Henry Duckworth and Herbert A. Stanton; directors, George I. Alden, Charles L. Allen, George N. Jeppson, Aldus C. Higgins and R. Sanford Riley.

Opens Cleveland Office

The Standard Sand Co., formerly the Standard Sand & Machine Co. recently has opened new offices at 929 E. 4th St., Cleveland. C. A. Patterson formerly secretary and general manager of the Fulton Foundry & Machine Co. has disposed of his interests in that firm and now is secretary-treasurer, the Standard Sand Co.

When repairing water jackets of motor car cylinders, the welder sometimes can use copper advantageously to seal cracks. Little or no preparation is necessary and the heat required is not sufficient to cause trouble from local expansion. In other words, small cracks may not require the cylinder block to be preheated to seal with copper.

Combines Steel and Alloys Casting



German Steel Castings Firm Also Makes Special Ferrous and Nonferrous Alloys —Manganese Favored

BY HUBERT HERMANNS

SINCE its foundation in 1910 the Mark Steel foundry at Wengern, Germany has been enlarged several times. It now turns out open-hearth steel castings and also produces metals and alloys used in refining steel and other metals. It represents an interesting example of a modern postwar German castings plant. In planning the works primary importance was attached to the handling of the raw materials, pig iron, scrap, and fuel. The plant is situated near Wengern Station in Westphalia on the Hattingen-Hagen railway. The site is comparatively favorable, as it enables the raw materials to be procured within short distances, thereby ensuring low freight costs. Fig. 1 shows the general arrangement of the works, which is connected with the railway line by a private spur.

Lift Stock with Magnet

The railway spur from the main line runs first through the scrap and pig iron storage yard, so that the incoming raw materials can be unloaded easily by a magnet crane. Adjoining the scrap and pig iron storage yard is the gas producer house, to which is attached a coal shed with bins for storing gas coal. Then comes the sand-preparation room with sand treating equipment.

The aim of the designer was to route the raw and auxiliary materials as directly as possible and to avoid unnecessary detours. For this reason the cleaning room directly adjoins the main foundry building, while next to it are the machine shops in which the castings are finished. The sand-preparation room is connected with the foundry building by an aerial ropeway.

The foundry building proper contains three parallel bays with a total length of 493 feet, the center shop being 59 feet and those on either side 36 feet. The center bay serves as a casting house and molding room; one of the side bays contains the furnaces, the other being used as a storeroom for the flasks. The foundry, the cleaning room, and also the machine shops are amply provided with cranes. In the main center bay there are two 15-ton overhead traveling cranes together with one of 25 tons and another of 40 tons capacity, so that rapid and economical conditions of work are insured. The side bays contain three similar 10-ton travelers, the cleaning room one traveler of 7½ tons and one of 40 tons capacity. Fig. 3 shows the foundry building in section and Fig. 2 the ground plan.

The furnace room contains two open-hearth furnaces of 35 tons capacity each and one furnace of 40 tons capacity, together with two heating furnaces. The furnaces are installed so that they can be directly served by the available lifting apparatus and so they can be charged easily and rapidly. The open-hearth furnaces are charged by an electric traveler of 10 tons capacity and with a span of 33½ feet. The charging boxes are filled by the magnet crane, which has a span of 65 feet and a capacity of 10 tons. This crane runs across the iron and scrap storage yard, and is also used for subsidiary work, especially for serving the drying ovens and heating furnaces. The cranes working in the center bay, of which the 25-ton and the 40-ton crane are used as ordinary foundry cranes, have a span of 57½ feet. At the top of the casting house are the fires for drying the ladles. The center bay also contains several saws for cutting off risers. The tapping spouts of the furnaces are immediately above the floor level of the foundry and during the tapping, the ladles are lowered into pits. The molding sand is handled and distributed by an aerial ropeway running along one of the rows of columns and connecting with the sand-preparation room.

Flasks Stored in Side Bay

The second side bay serves mainly as a storeroom for flasks and also is used for molding light castings. It is served by two cranes with a span of 33½ feet and capacities of 5 and 10 tons respectively. Running across the end of the foundry is the cleaning room, which has a length of 192 feet and a width of 33½ feet. The drying ovens are located on both outer sides of the building; on the opposite side from the gas producer house is a core-

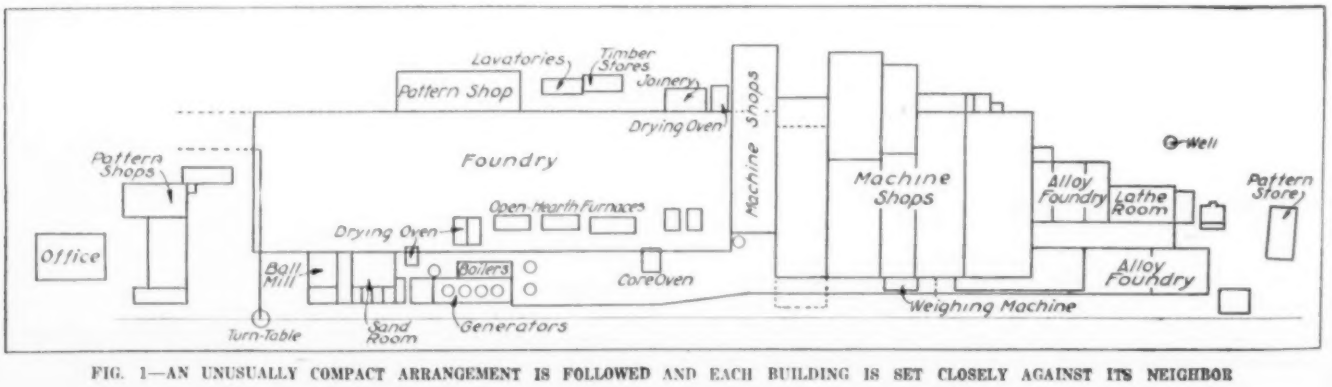


FIG. 1—AN UNUSUALLY COMPACT ARRANGEMENT IS FOLLOWED AND EACH BUILDING IS SET CLOSELY AGAINST ITS NEIGHBOR

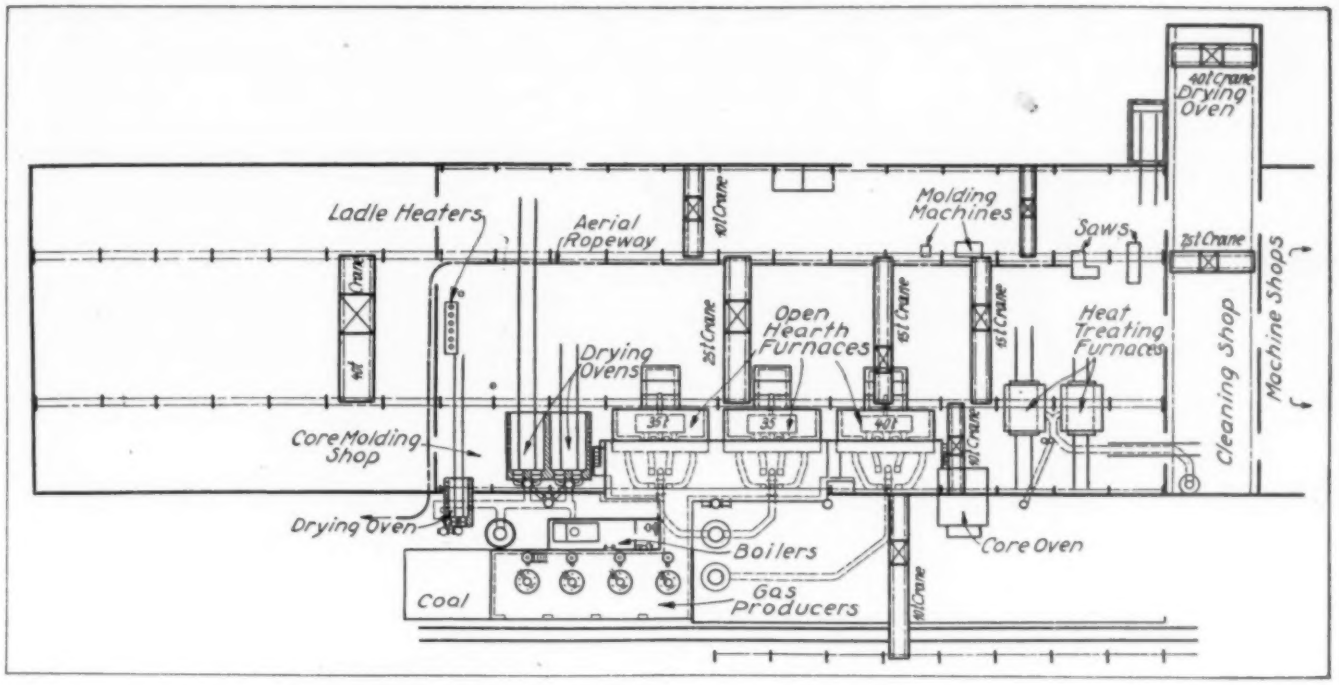


FIG. 2—PLAN VIEW SHOWING THE ARRANGEMENT WITHIN THE FOUNDRY BUILDING

drying oven. The pattern shop is completely equipped.

The gas producer house contains four rotary-grate producers. The boiler house and a ventilator chamber to supply steam and air for working the gas producers are built next to the gas-producer house, facing the steel foundry. Fig. 5 shows the gas-producer building in section and the piping arrangements. The gas coal is brought in on a lateral track and shoveled by hand on to the producer platform.

The machine shops adjoin the cleaning room. They are mainly equipped for the finishing of large castings, such as machinery housings, ships' parts, etc. These shops contain a number of high-speed, heavy, automatic tools, such as lathes, planing-machines and drills; they are also equipped with the necessary lifting appliances of ample power. The Mark works does not actually construct machinery; only individual parts are made and supplied to engineering works in a finished or semifinished state.

As previously stated, two of the open-hearth furnaces have a capacity of 35 tons each and the third an output of 40 tons; they are equipped with regenerators installed beneath the floor level. The furnace hearths are 19 feet 3 inches long and 8 feet 4 inches wide. The installation of the furnaces shows no special points of interest. In the formation of the upper part the smallest possible use of refractory bricks and a good flame baffling were aimed at in order to reduce the cost of renewals and repairs. The total capacity of the gas chambers is 725 cubic feet, that of the air chambers 990 cubic feet. Thus, the ratio of the chambers to the air chambers is 1:1.4. Between the regenerators and the furnaces, slag pockets are inserted which catch the slag dropping from the ports and the solid bodies carried off by the gases. The furnaces are heated by lignite gas. The reversing gear, with a siemens valve for the air and Fischer valve with water packing for the gas, is in a vault, the roof of which is formed by the charging platform of the furnaces. By means of sliding valves installed in the connecting channels the flow of the escaping gases can be regulated separately. The two 35-ton furnaces are connected with a common chimney 154 feet high and 5 feet inside diameter at the top while the 40-ton furnace has a separate chimney of similar dimensions to the one described.

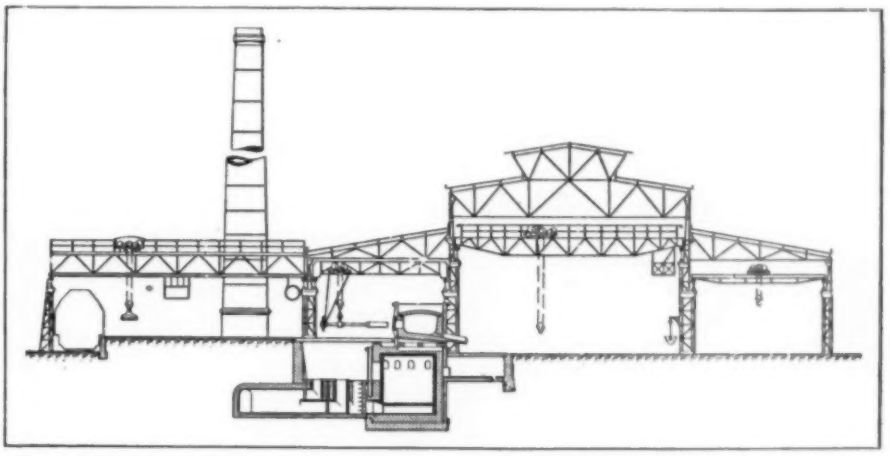


FIG. 3—ENTERING MATERIALS CROSS TRANSVERSELY TO THE FURNACES AND THEN FROM THE MOLDING FLOOR LONGITUDINALLY THROUGH THE SHOP

The drying ovens, like the open-hearth furnaces and the heating furnaces, use gas fuel. The construction of the drying ovens is indicated in Fig. 4. Their dimensions are 15 x 24 feet. The ovens are heated by two burners attached to one of the walls, while the heat of combustion is regenerated in several flues located below the hearth level and running parallel with the chimney flues. The combustion gases pass through the flues situated below the hearth level close to the door openings. The waste gases from the drying ovens are carried off through a common chimney 154 feet high and 4½ feet inside diameter at the top. Steel water tanks with a capacity of 21,000 gallons are built around the chimneys near the top. One of these is shown on the stack at the left in photograph.

The gas-fired, heat-treating furnaces,

with a floor area 11 x 19 feet, have movable hearths, which are equipped in a similar manner to the drying oven carriages with roller bearings, but with the addition of a layer of refractory brickwork 8 inches thick. The sides of the car are sunk in grooves filled with sand, which protects the heating chamber from the outer air. The gas burners are fixed

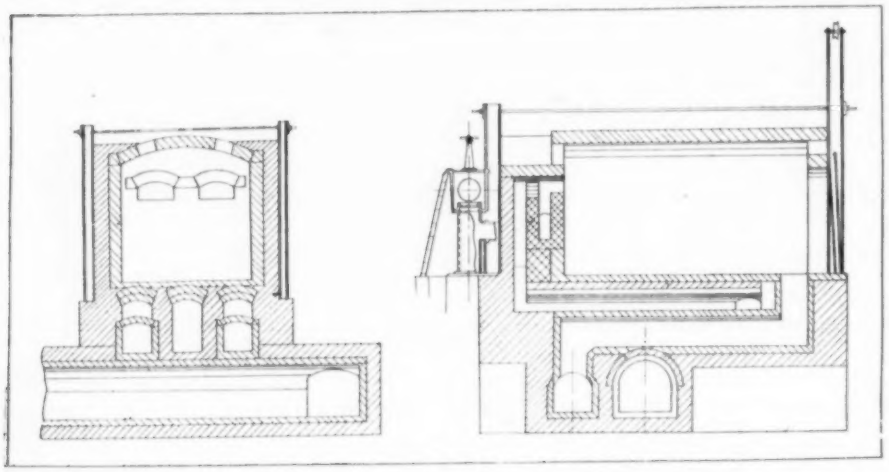


FIG. 4—GASES PASS THROUGH THE DRYING OVENS AS INDICATED, GIVING A MODIFIED REGENERATIVE EFFECT

on one side of the furnace and produce a uniform temperature in the furnace chamber. The air for the combustion is forced at low pressure through a ventilator into the furnace and regenerated in a regenerator consisting of a number of parallel smoke and air flues. The gas is not regenerated. The chimney for the heating furnaces is 96 feet high and 3 feet 3 inches inside diameter at the top.

The gas-producer building, which is 77 feet long and 28 feet wide, contains four rotary-grate gas producers, each 16½ feet high and with a diameter of 7 feet 4 inches. The coal hopper is charged by hand. The gas, which is distilled from lignite briquettes, has proved suitable for working the furnaces. The average analysis of the gas is as follows:

	Per Cent
Carbonic acid	3.50
Heavy hydro-carbons	0.25
Carbon monoxide	32.00
Hydrogen	12.50
Methane	2.50
Nitrogen	49.25
Total	100.00

The gas obtained from lignite causes but little dirt in the mains and shows only slight traces of sulphurous acid. The working of the gas producer with lignite briquettes involves little stoking.

The gas main is laid above ground and is connected with the generators by an inclined connecting pipe in which a stop-valve is fixed and a dust pocket inserted. The gas-collecting main has a refractory lining and is provided at either end with openings, which can be closed, so as to facilitate cleaning. The gas main also can be cleaned by being burnt out. This is done by connecting it with one of the chimneys of the open-hearth furnaces by a loose bend. A slow moving current of gas is employed so as to obtain gas as free from dust as possible and to effect a separation of the dust carried down in the main flue.

All the gas flues are provided with explosion valves, to insure safety in operation. In addition, a pipe, which can be shut off by a slide-valve, connects each producer with the outer air, to enable the gases formed when the producer is kept warm to escape. This arrangement also enables the gases to be let off in case the ventilator fails to act, thereby preventing the formation of an explosive mixture by combination with the air in the blast pipe.

The sand-preparing room is connected with the molding room by an aerial ropeway as previously stated. The fresh sand is shoveled directly from the railway cars into the storage bins when it arrives. The building together with the storage bins, is 45 feet wide and 52 feet long. It is so designed that the work can be performed on the most economical basis. Fig. 6 shows the ground plan and section of the sand preparing room. The old sand is brought up to the preparation room by the aerial ropeway and shaken into the boot *a* of the elevator *b*. Beneath the funnel is a roller grinder, *c*, which crushes and grinds the lumps contained in the sand. The elevator *b* conveys the sand to the electromagnetic separator *d*, which eliminates iron and steel residues. These are carried by a chute to the foundry floor, while the molding sand is caught in a container beneath the separator.

The fresh sand, shoveled by hand from the storage bins, is introduced into the boot *f* of the elevator *g* Fig. 6 and carried by the latter to the collecting container *h*, below which a shaking trough is fixed. The outlets of the two containers *e* and *k* are provided with automatic distributing devices, by means of which the sand can be introduced in a precise proportion into the mixing and grinding machine standing between the containers. In this machine the old and the fresh sand are intimately mixed, ground and crushed, leaving the machine at *i* in condition for use. The finished sand drops through the chute *k* into the elevator *l*, which carries it to the screw conveyor *m*. Beneath the latter are arranged four containers *n*, each of which can be filled independently. They are furnished with outlets provided with round valves. The entire plant is driven by an electric motor.

The Mark plant manufactures steel castings from the lightest to the heaviest description. Castings with a maximum weight of 40 metric tons can be turned out. The castings are molded mainly by hand, but a few molding machines also are available, particularly in order to turn out gear wheels, running wheels and similar articles with the minimum expenditure of time and labor. Pneumatic tools driven by air at a pressure of 100 pounds per square inch are used on an extensive scale for ramming the molds and for cleaning and chipping the castings. A compressor driven by a 100-horsepower motor is installed for the production of the compressed air. The electric current for the plant is supplied by the West-

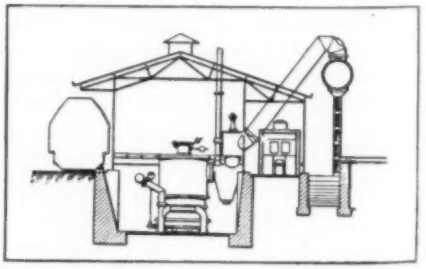


FIG. 5—SECTION THROUGH THE GAS PRODUCER BUILDING

phalian Electricity Works in the form of high-tension 3-phase current and is converted into continuous current of 220 volts in vertical transformers.

In addition to carbon-free metals used in refining steel, such as manganese, chromium, molybdenum, titanium, vanadium and wolfram, the various alloys are produced at the Mark works, for example, manganese-cop-

per alloys, manganese alloys with tin and zinc, chromium-copper, chromium-manganese, chromium-molybdenum, chromium-nickel, molybdenum-nickel, manganese-titanium, ferrocopper, ferro-titanium, ferrovanadium, ferromolybdenum, ferrochromium, etc. Carbon and iron-free manganese containing 97-99 per cent of manganese is a brittle metal, which is easily crushed with the hammer. It keeps for any length of time when exposed to the air, whereas manganese containing carbon decomposes when exposed to the air. Alloyed with other metals it produces a compact casting free from blisters. Owing to its low melting point of 1200 to 1300 degrees Cent., it can be easily alloyed with copper, nickel, zinc, tin, boron, titanium, and other metals.

The main cause of failure in making these bronzes lies in the method of pouring into the molds. In each case an adequate number of large gates and risers must be provided. The gate should be on the side of the casting, beside it being a riser facing the casting and above the casting itself another riser. The riser should have approximately double the diameter of the gate and should open into the latter. Pouring must be begun slowly and small castings must be accelerated as soon as the metal reaches the mold. The gate must then be kept filled until the metal rises above the mold. Heavy castings must in all cases be poured slowly.

To avoid spoiled castings the manganese-bronze must be poured cooler than any other metal. The ladle must be placed as close as possible to the runner. To avoid blisters or insufficiently filled spaces, the molten runner should be well stirred after it has been poured so as to force as much metal as possible into the mold. These bronzes show extraordinary resistance to acids and salt water. For this reason they have been employed largely in marine work—for ships' screws, turbines and pump wheels.

Manganese Added

Manganese is also used instead of the usual magnesium as a 2 per cent addition to nickel or copper-nickel, to which it imparts a greater density. A manganese addition of 0.5 per cent to nickel silver makes the alloy more compact and ringing, making it easier to alloy and increases its whiteness.

The following is recommended as a suitable composition for manganese-nickel silver:

	Per Cent
Copper	50 to 54
Nickel	15 to 19
Zinc	5 to 9
Manganese	1 to 5
Phosphorus, not more than	0.5

With aluminum, a manganese addition of as much as 2 per cent makes a more compact casting and renders its further working easier. Aluminum alloys containing manganese have lately been used in Germany with good results for electrical purposes. Manganese-copper is also suitable as a substitute for bronze and for the production of articles which do not depend so much upon the hardness of the alloy. In many cases manganese-copper is used as the basis of alloys containing zinc, tin or nickel.

Efforts have long been made by the Mark plant to produce ferro-chromium as pure and free from carbon as possible. Interesting results, from a technical standpoint, have been shown in the comparative metallographical examination of carbon-free and low carbon ferrochromium.

For the determination of the melting point of a carbon-free ferrochromium as compared with that of an alloy containing carbon, a crucible with ferrochromium containing 5.5 per cent of carbon and one with carbon-free ferrochromium was exposed to the same temperature of 1700 degrees Cent. for 5½ hours. Whereas the carbon-free ferrochromium at the end of this time was entirely fused, there was only partial fusion in the case of the ferrochromium containing carbon. This fact has also been established by experiments of the government department for the testing of materials in the laboratories at Berlin.

The cooling curves of carbon-free and low carbon ferrochromium with 0.6 per cent carbon shows, for the former the absolute melting point is 1430 degrees Cent., for the latter, 1450 degrees Cent. In the first case, solidification is complete at 1265 degrees Cent., in the second case, at 1214 degrees Cent., thus showing an interval between the beginning and completion of solidification of 165 degrees in the case of low carbon ferrochromium. In this case also the difference is due to the presence of chromium carbides and metallic oxides. While no separation of constituents occurs in the case of the carbon-free ferrochromium, in that of low carbon ferrochromium small quantities of impurities separate out at 1214 degrees Cent. and affect the residue of the ferrochromium.

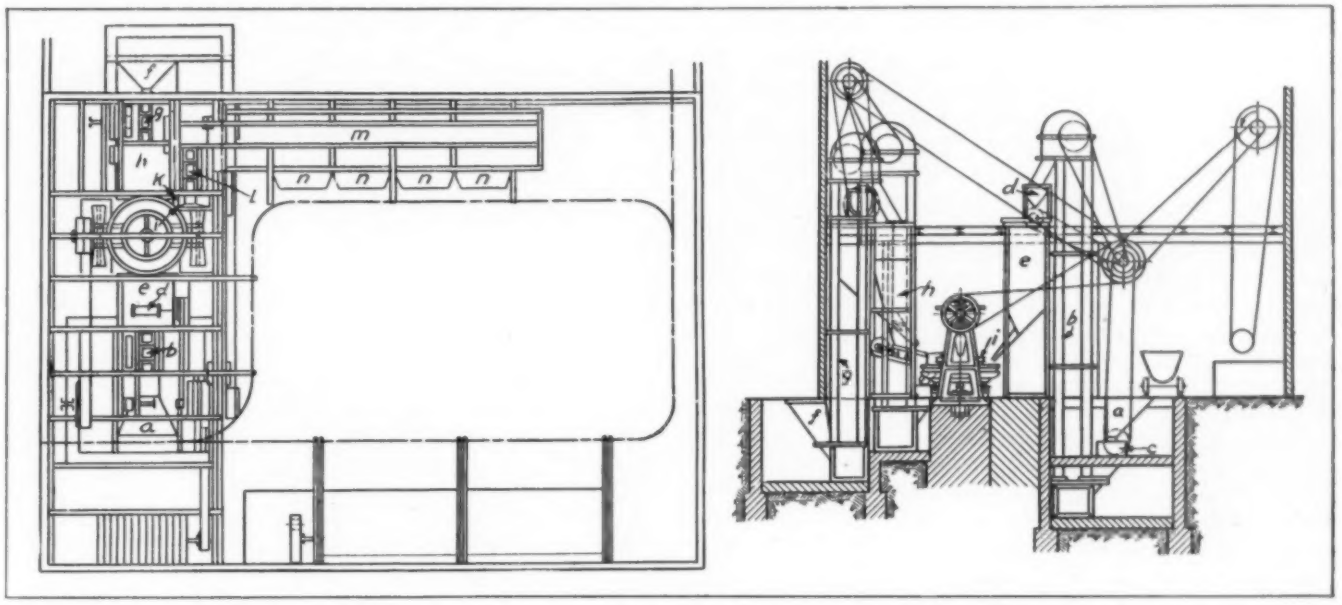


FIG. 6—AS IS CUSTOMARY IN GERMAN FOUNDRIES THE SAND RECLAMATION SYSTEM IS OF PRIME IMPORTANCE—PLAN AND SECTIONAL VIEWS OF THIS DEPARTMENT

Employment Manager Has Problem

The Importance of Creating a Friendly Atmosphere and Cultivating a Feeling of Personal Contact Between the Employer and the Applicant for a Position Is Emphasized

BY A. H. YOUNG

A FEW years ago the great majority of industrial plants were either owned by individuals or by small groups of individuals. The plants themselves, employing possibly 200 or 300 employes, were relatively small compared with their modern successors. The owners knew every man by name, also their children and knew when the latter would be through school and ready to go into the shop. There was a happy, intimate, human contact.

Contrasted with that condition we now have ownership by stockholders. Each of the big corporations today has thousands of stockholders who elect a board of directors, they in turn select a staff of managers to take charge of the business and as a result a wide gap is created between the actual owners and the rank and file of the employes; the personal contact feature has been wiped out. This condition has been further accentuated by the line along which big business has grown. Power development and transmission have been perfected to a point that great manufacturing units have been made possible. Improved methods of transportation and communication have also been factors in creating plants that number their employes by the thousand where they were formerly numbered by the hundred. All this has had the effect of making personal and intimate contact impossible, even between the managing representatives of the stockholder-owners and the workers.

In the old days, getting the right man on the right job was not much of an operation. We did not have employment methods then. I think one can rightly say that the matter of hiring a man was nothing more or less than crooking your finger. If a foreman at the beginning of a turn found a machine idle because of the absence of one of the men, he simply went out to the gate, looked the bunch over, picked a likely looking applicant, and beckoned to him. The man stepped out of the line, the foreman put his proposition up to him, and if he accepted, the foreman said, "All right; come on and go to work." When the timekeeper came around he was notified that this man was at work and to put his name on the payroll.

Centralized Employment Needed

The obvious inefficiencies of that method did much to bring about eventually the formation of centralized employment departments. In the first place, the selection of a man at the gate involved the absence of the foreman from his department at the time he was laying out the day's work and was needed on the job more than at any other time. Furthermore, regardless of how efficient a foreman he might be, he occasionally made a bad guess. Sometimes, although an applicant was likely looking, it would be found after a day or two that he was a "four-flusher"—he wouldn't work. He therefore, was "fired." There was no formality about it; he was simply told to get his time from the cashier. What was the result? The man showed up with the others at the gate the next morning, looking for a job again, and another foreman was likewise impressed by his appearance, and he likewise crooked his finger, and the man was taken on again, with the same result. There are cases on record in some plants where the same man has been hired and fired 10 or 12 times, and for the same cause each time—because he wouldn't work. There was no central clearing house; no passing on of the information that the first man hiring him secured.

Contrast that method with that of today. First of all, when a man is desired for any particular job, a requisition is sent in to the employment manager. And what type of man is he? The employment manager of today is chosen, not because he has had a college education, not because he is a phrenologist or psychologist, or has any sort of mystic wand with which he can make men reveal their true selves and discover which are the workers and which are not; he is chosen chiefly because of his personality and his vision of his opportunity to serve his fellow man.

My conception of the employment manager's job is that he is simply a coarse sieve; that he will be able, by intelligent inquiry, to sift out the manifestly unfit applicants—men with the poor records, the men who cannot intelligently answer the questions he puts to them, and the men who, by their attitude, show that they are undesirable as employes—and to send in to the foreman the best applicants he can get, the foreman to judge of the man's final fitness for the job by his actual performance and his shop attitude.

Therefore, the first requisite of an employment manager today is that he shall know in detail the duties of every job in the plant. He should not only know the idiosyncracies of the foreman in order to decide what type of man he is going to put with him to get along satisfactory, but he should know intimately the physical and mental requirements of every job in the shop. He should have in his files a set of specifications for each job and a record of the general characteristics a man must have in order to meet these specifications, and when a requisition comes in, he instantly must be able to visualize the type of man he must get to do the work.

Having selected an applicant who promises to be favorably considered by the foreman, the next operation on the part of the employment manager of the modern plant is to refer him to the doctor for a complete physical examination. The purpose of this is, not that industry proposes to rid itself of all men who are not physically perfect, but that no man shall be assigned a job that will work a physical hardship upon him. For instance, if a man has a bad hernia, or a serious heart lesion, it is manifestly unfair to put him at a job where he must do heavy lifting or where he must run up and down stairs often. If he has incipient lung trouble, or chronic throat trouble, it would be wrong to put him at work where dust and fumes prevail. If a man has a communicable disease, he should not, of course, be put to work among other men.

Having completed the examination, the doctor, we will say, classifies the men as *A*, *B* or *C*.

Class *A* means that the man can take

From a paper presented at the convention of the American Foundrymen's association held at Columbus, O., the week of Oct. 4-8. The author, A. H. Young, is connected with the International Harvester Co., Chicago.

any job in the shop without fear of its working a physical hardship upon him. His condition is such he can do the work.

Class *B* means some disability which would debar him from certain occupations, and this means that the employment manager should call up the doctor, describe the proposed job, and get his O. K. before that man can go to work. Furthermore, if, after having put him to work, he is later transferred to another job, it should be the duty of the employment manager to call up the doctor again and clear with him about the new job, because it is just as important that a man be cared for after employment as before.

If he is rated in class *C*, the man is rejected. This might be for some communicable disease, or because the man had lost the sight of one eye. It is a rule of many foundries that a man who has entirely lost the sight of one eye shall not be hired. The reason for this is two-fold, and both are fair. In the first place, it is hardly square to put a man who has all his eggs in one basket in a position which will expose him to greater hazard than he would encounter in many other lines of industry, and while it is true that a man with one eye can see almost as well as a man with two, still, if anything happens to the other eye, he is totally, permanently disabled. In the second place, under the present compensation act, if a man lost the sight of his second eye while at work, the industry employing him would have to pay for total permanent incapacity, which means either a series of monthly payments extending over life, or a large sum in total cash settlement. This is hardly a fair proposition, and for those two reasons it is best, in a hazardous line of work, to reject men thus handicapped.

"Sells" Company to New Man

The applicant having been O. K.'d by the doctor, it will next be the employment manager's job to "sell" the company to him, tell him something of the history of the plant, and what promotional opportunity there is there for him. Some plants make a practice of giving new employes a motion picture show or illustrated lantern slide lecture, showing first the town, the location of the plant, the different resident districts, the names of the streets leading to the plant, the surrounding country, then a view of the plant itself, the gates, the pay stations, etc., and then, by means of photographs and diagrams, the whole process of manufacture at that plant.

The new man should then be personally escorted to his job by some one from the employment office, who on the way will point out the safe path of travel, show him the gate where he is to come in in the morning, point out the store room, lunch room, locker and toilet rooms, and other things in which he may be interested, and then turn him over to the foreman, introducing him by name. The foreman will shake hands with him and make sure of getting his name right; then he will explain his new work to him, tell him of any hazards in connection therewith, and introduce him to two or three of his fellow workmen by name. In other words, that new applicant should be invited into some sort of human contact with his fellow workmen. He should be made to feel that he is recognized as a human being with a soul—not a mere cog in the machinery.

The wise employment manager will also have in his files a list of substitute occupations. He will find out at the time a man is employed what his aspirations are and what he may be studying to fit himself for. Then, too, there are times when a man is hired for a certain position who is capable of something better, but there is no opening in his particular line just at that time. By maintaining such a file, the employment manager will be able, when a requisition is received for a man with those qualifications, to offer this promotional opportunity to a present employe, rather than hiring someone from the outside. This will do much to aid continuity and stability of service.

I have heard it said many times that the work of employment management consists in fitting square pegs into square holes and round pegs into round holes, making sure, if you have a square peg in a round hole, that it is changed, through some fine system of accounting, and put in a square hole. And I respectfully say that it isn't anything of the kind. In the first place, you cannot classify jobs as square and round, and you cannot classify men as square and round pegs.

If a simile is to be used for the operation of employment management I would say it is like the process of fitting a key in the keyway to hold the pulley on properly. If you are a real craftsman, you select a bar of steel and draw the temper. If in trying to draw the temper you find the steel is unfit for that job, you lay it aside to be used for something else. Then you pick out another bar, work it down to a rough shape, then you put it in the vise, file it, and work it down until it will almost fit in that keyway. You chalk it and try it again; there is a rough spot here and you file that down; or, if you run across a flaw you put it aside and start all over again, if necessary. And when you get through, if you are a real craftsman your pulley rides on the shaft smoothly and the last little tap of your hammer locks it in position without sledging. If you sledge it into place it may hold your pulley, but you may knock a bearing out of line, or the shaft itself may be out of line, and when the time comes later that you want to make a little adjustment or take it off altogether, you have to work for two or three hours to get that key off, whereas if you had been a real craftsman in the first place, one or two slight pulls of your tool would have been sufficient.

Harmony Promoted

Employment management, properly done by real craftsmen, will keep men and management performing their full functions in complete harmony and without friction, and that is the essential purpose and effect of getting the right man on the right job.

Recently I heard four employment managers, at four different times (and they had not cleared with each other at all) express this thought: Whereas they used to think that the golden rule, "As ye would that others should do unto ye, do ye also unto them," was the finest text in the Bible and should be the rule and guide to all, they had recently come to believe that another text a little farther along in the book of Mark was still greater—"He among you that would be greatest, let him be the servant of all."

I respectfully say to you that the basis of sound industrial relations lies certainly within those two texts, if not within the last alone. And I say that the latter is the greater, because sometimes this proposition of doing unto the other fellow as you would have him do unto you is construed to be just a square deal, a "fifty-fifty" policy, and some of us take the attitude that we will come up to the "fifty" mark and if the other fellow comes up we will meet him half way and go along together, but if he doesn't do his part, that is no concern of ours.

But we cannot afford to take that attitude, because the other fellow may not have had the same advantages we have had. He may have been subject to radical propaganda that we do not realize at all. If we will sweep all distinctions aside and simply conceive, as the Carpenter of Nazareth did, that he among us who would be greatest should be the servant of all, we will, I believe, be able to get together on a basis which will help to make for the universal brotherhood of man.

Science Is Required in the Workshop

When the Scientist Fully Realizes That There Are Practical Problems Only Capable of Solution by Practical Means, the Application of His Theories Will Be Simplified

BY W. H. CATHCART

TO OVERCOME the prevailing prejudice among practical men against science, it is necessary to get them to realize that science and practice are not opposed. On the contrary they are inseparable. Every practical man who knows what he is doing is a scientist. When he does not know what he is doing he ceases to be a practical man. So long as he persists in carrying out his work in accordance with haphazard, rule of thumb methods he is not a craftsman in the truest sense. It is exceedingly difficult to make craftsmen realize that the so-called scientific method is not a new institution. Every successful practical operation is performed according to scientific principles, even though the craftsman may not be aware of the fact.

It would appear as if there were an impression abroad amongst some people that a craftsman is only a manual worker, a kind of superior laborer, whose chief qualification need only be that of doing quickly just that which he is told without any initiative on his part.

If it were not that the expression of such opinions is calculated to do much harm in hindering the co-operation of science and industry, one would feel disposed to pass over without any comment the remark to the effect that the practical man should be exterminated. Of course, such an attempt might well be successful if all those who are to supersede the practical man were so clever as to justify the further remark that "he would guarantee that in three months' time any scientist would learn as much as a practical man had learned in his lifetime, and in that of his father's and grandfather's, from whom most of his experience was derived."

It may be somewhat superfluous on my part to emphasize the fact that the pioneers of industry, the practical craftsmen of the past, with all their lack of the scientific knowledge which is available today, have left on record for all time many evidences of the fact that they were possessed of intelligence and genius of the very highest order. I maintain that the potentiality of the craftsman of the present day is greater than that of his forefather, because of the definite and more reliable knowledge which has been secured through the brilliant research of our distinguished scientists.

Knowledge Not Applied

Not as a matter of opinion, but as a matter of actual knowledge, I assert that, in the course of pure scientific research, scientists have accumulated a vast amount of valuable knowledge which is not fully taken advantage of. One reason for this is the inexperience of the scientist concerning workshop practice. Another reason is that practical men are unaware that such knowledge exists. The obvious solution is that each should realize he is the complement of the other, that each is of equal importance, and that by working in co-operation and harmony greater benefits to industry and mankind may be reaped from the labors of all.

Now, the practical man is not entirely to blame for his ignorance. Not many years ago scientists knew no more than he did, and in many respects much less. Scientists, by reason of their having the time and the facilities not afforded to the practical man, have been able to find out more and more about the laws and properties of materials, but the man in the smithy, the forge and the foundry, for various reasons not altogether to be blamed on anyone, has not been kept in line with the increase of knowledge.

For example, long before scientists discovered the various critical points in steel, tool smiths, who are as a rule careful and observant workmen, had been able to heat to just above what is now known as the Ac1 point. How many toolsmiths know that not only have scientists also discovered the Acm point, but that it is a temperature of great importance? A friend of mine, despite the fact that he had been heating pyrometrically to above the Ac1 point, had failed repeatedly to produce without fracture a certain important tool. On examining the steel, I found evidence of gross initial overheating. By heating to above the Acm point and quenching in oil, and then re-heating and treating as in the case of all the previous failures, success was secured.

I have been deeply impressed by the significant fact that many of the investigations carried out in connection with metallurgy, many of the papers read and lectures delivered, have all been done without sufficient effort being made to induce the very craftsmen who could best utilize the valuable knowledge obtained in this way to take an interest in these matters. In the interests of industry, it is absolutely necessary that the craftsman in the smithy, the forge and the foundry should be conversant as fully as possible with the progress of investigations pertaining to his craft.

A foreman smith called on me soliciting my assistance in connection with forgings which were held up because of failure to pass the mechanical test. At the time of the first failure permission had been given to heattreat the material. This was carried out in all sorts of ways, to be followed each time by a result no nearer the requirements than the first. The inevitable conclusion was arrived at that the steel must be bad. In accordance with this finding, arrangements were made for another firm to supply new steel. Be it noted that all this took time, and at a period of the war when every moment was precious.

The first test from the new forgings failed. Heat treatment was again resorted to, but evidently this steel was no better than the first. My friend was utterly perplexed; his manager was little better. The remainder of the mechanism was all assembled, was lying idle, and had been so for no less a period than three months waiting on these important forgings.

In less than three days after our interview the forgings were correctly treated, the tests were passed satisfactorily, and the nation was in possession of material in the best possible condition. Not only so, but by subjecting the first *bad* steel to exactly similar treatment, I obtained excellent results fully complying with the specification.

Not only is the usual subterfuge of blaming the steel most unfair unless when it is really known to be the case, but it is frequently a very serious hindrance to all real progress, for, after making the assertion, there the matter invariably ends, and consequently there also ends all hope or possibility of learning the

From a paper read before the Institution of British Foundrymen at the annual conference held in Glasgow, 1920. The author, W. H. Cathcart, Blacksmith gold medallist 1920, is connected with the Lobnitz Shipbuilding Co., Renfrew, Scotland.

true cause of failure, which for obvious reasons is very desirable.

The foregoing example serves to prove that the scientist does add very considerably to the knowledge which is essential in the workshop; that lack of such knowledge on the part of the practical man does lead to serious delay and disaster; that it is the practical craftsman who must become possessed of this knowledge; that any average intelligent craftsman is quite capable of applying the necessary scientific principles: and that the science teacher ought to fully appreciate and conscientiously deal with these important facts.

Craftsmen Are Intelligent

From the mind of the craftsman, therefore, and if it be really a fact (which I do not for a single moment admit) that he has been endowed with a lower order of intelligence, then that is all the greater reason for his being trained to the very limit of his capacity.

There has been a great deal of talk about scientific control in the workshop. With this I most heartily agree, but with some of the suggestions regarding the manner of the control I do not agree. It has been suggested that members of the laboratory staff should be trained to become the future captains of industry. If they receive an adequate training in the particular craft, and have the other necessary qualifications, I have no objections whatever to their entering the field, but why train them to enter a province which legitimately belongs to someone else, especially when there is so much scope for their particular training and abilities in a direction which I am sure would be far more beneficial to science and industry?

I maintain that, by adopting some system for the scientific training of young craftsmen, it should be possible to secure workmen, foremen and managers that could not be equalled. I contend that the works manager should not only be strongly in sympathy with scientific methods, but that he should be in possession of a considerable amount of scientific attainments. His departmental managers and foremen should all be men who have actually worked at their craft, and who have received the necessary scientific training pertaining thereto.

It is true, of course, that we cannot obtain these ideal conditions all in a moment, but I suggest that in the future as much care be exercised in selecting lads for any craft as for the laboratory. While they are being taught how to manipulate their tools in the most expert manner, they should at one and the same time be taught the scientific laws which govern everything they do. These lads should be examined periodically in knowledge and ability, and be graded accordingly. As the result of these examinations, the bulk of them would remain in the workshop as craftsmen, those of the lower grade doing the less important work, and those of the higher grade carrying out the work requiring greater knowledge and skill. Certain lads who gave evidence of exceptional aptitude and ability might well be transferred to the laboratory to undergo special training in keeping with workshop practice. As time went on it might be found desirable to retain the services of some of them in the works laboratory, while the others would return to the workshops for the purpose of controlling the work, and also providing an excellent field from which to select the managers and foremen of the future.

It must not be forgotten that there is a large number of small works throughout the country where there is no laboratory. There are, however, excellent technical schools and colleges where the intelligent craftsman can receive a knowledge of the scientific principles which govern his craft. I know that many of the craftsmen of the present day speak rather lightly of professors and other science teachers, but, even in cases where the science teacher had no knowledge whatever of the practical application of the principle which he was teaching, that did not in the least alter the fact that the craftsman was able to apply it profitably in the workshop.

It is not a question of the laboratory controlling the workshop; it is a question of science controlling the workshop, which may be quite a different matter. No one can deny that, if it were possible—all other qualifications being present—to have a combination of the knowledge of the scientist and the craftsman, we should have the ideal controller of the workshop. While it may not be possible to attain such an ideal, something approaching it might well be secured.

To be an ideal manager or other controller of the workshop, it is not necessary on the part of craftsman to have the profound knowledge of the scientist, but it is necessary, on the part of the scientist, to have the profound knowledge of the craftsman. Whether, therefore, it is easier to give the craftsman just the amount of scientific training which is necessary, or to give the scientist the wide and varied practical experience necessary should be decided.

The right way to bring about the scientific control of the workshop is to secure, first of all, the kind of managers, foremen and workmen whom I have indicated. We already have the right kind of research workers and others in our colleges, schools, works laboratories, and elsewhere. By instituting a system of co-operation between the laboratory staff and the managerial staff, each exercising a feeling of mutual respect, realizing that each is of equal importance and is truly the complement of the other, then we may hope to be making progress towards the true collaboration of science and industry.

Cores Stick to Drier

Question:—We are having trouble with a radiator core for a furnace. This core is made in a drier approximately 4 inches wide, 12 inches deep with a 5-degree draft on the sides. When we use flour in the core it is almost impossible to clean the sand out of the casting and when we use an oil core sand mixture it is impossible to get the core out of the drier.

We have been told that these cores are made elsewhere in green sand on some form of collapsing anchors and if the idea is practical we should like to apply it to our product. This arbor would have to be removed from the casting through a 5-inch square hole on one side and an 8-inch diameter hole on the other side. Any information you can give us on these points will be highly appreciated.

Answer:—The fact that you experience considerable difficulty in cleaning a flour-bonded core out of the casting would seem to indicate that you were using too much flour, too much molding sand, or both, in your core sand mixture. Since you are making the core in a drier, the proportion of bonding material can be reduced to a minimum. Cores for this class of castings are made just strong enough to handle when they are dried.

One reason why your oil sand cores stick to the drier may be because you are using too much oil, second reason may be because your oven is not operated at the proper temperature which is 450 degrees Fahr. for oil sand cores. A third reason may be because your drier is not provided on the bottom and sides with vent holes. Your trouble may be owing to any one or a combination of these causes.

Collapsible core arbors for green sand cores are employed in quite a variety of castings; but until we see a drawing of the radiator it is not possible to say whether the idea can be adapted.

We should suggest that you mix a *weak* batch of oil core sand, if your drier has no vents line the bottom and sides with a single thickness of old newspaper. Dry the core with a *hot* fire and rap the drier before attempting to remove the core.

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Resistance to Shock Sought

NOT many years ago it was difficult to purchase malleable iron castings with a guaranteed tensile strength of 40,000 pounds per square inch and an elongation of not less than 5 per cent. Now,thanks to the unified efforts of the manufacturers of malleable castings, who are working together under the direction of a consulting metallurgist with a highly trained staff of assistants, malleable castings with a guarantee of not less than 45,000 pounds per square inch tensile strength and 7.5 per cent elongation in 2 inches may be purchased. Even these figures, which once seemed excessive, are exceeded in some foundries which frequently make malleable iron with a tensile strength of more than 60,000 pounds per square inch and an elongation of not less than 10 per cent and as high as 30 per cent. These high tensile strength tests with uniformity guaranteed by daily tests at the central laboratory appear to be extremely gratifying especially as malleable iron, unlike steel, has a greater elongation with its higher tensile strength. Possibly this statement should be modified to include only the black-heart variety of malleable iron, as white-heart malleable, while it can be made with a tensile strength of more than 70,000 pounds per square inch rarely has a great elongation, and sometimes not more than 3 per cent with the 70,000-pound tensile strength. The feature of greater elongation with increasing tensile strength, then, seems to be peculiar to the black-heart malleable. This possibly may be due to the structure of the malleable approaching more nearly that of low-carbon steel which would have approximately the same tensile strength and a slightly higher elongation. If this theory is correct the object should be to secure carbon in such a finely divided state that it does not interfere with the continuity of structure of the ferrite and pearlite in the iron. Then, when the highest tensile strength and elongation are attained will the quality of malleable iron be all that could be desired?

It would seem so, but the qualities sought today differ somewhat from those which formerly applied to malleable. Years ago when the late B. J. Walker of the Erie Malleable Iron Co., was advocating so strongly the wedge test originated and standardized by him, little was heard of the tensile strength of malleable. The wedge test is applied by repeatedly dropping a definite weight a certain distance on the point of a wedge until the wedge cracks. The main advantage claimed for this metal was that it would stand shocks which steel could not endure. The delight of the foundryman was to batter a casting unmercifully and then to show it without a crack. Any malleable which would stand such punishment was considered highly fit and its tensile strength was not questioned. Since the high tensile strength malleable has been attained universally, little is heard of the old wedge test. If the high tensile strength malleable iron will withstand the wedge test to a degree anywhere in proportion to its strength or to its elongation, it is truly a valuable product, but if it will not withstand this shock test, possibly it is not as good for some purposes as the weaker metal which will withstand shock to the utmost. Some hold that this shock test should be more generally used and the reports of the results circulated among the factories employing malleable iron castings. Shock resistance is the field of malleable's eminent domain and it should be emphasized.

Trade Outlook of the Foundry Industry

SLIGHTLY better foundry operation is reported from some sections, notably in New England, but no general revival is yet in sight. An accumulation of orders in many instances has permitted castings manufacturers to start their plants again on a reduced schedule. Foundries supplying castings for the textile machinery and rubber industries through that section and general jobbing foundries in the New York territory are working on new business. Customers in many instances are sending out inquiries, which when answered by interested foundrymen are shown to be only feelers seeking price reductions. In some cases users of castings arbitrarily have set a price per pound which they state is the maximum that they will pay.

Bottom Not Reached

The general industrial situation has not changed to any marked degree in the past two weeks. Falling prices in many lines have failed to stimulate buying, and a wide discrepancy has developed between the prices for raw materials and those which are asked for finished commodities. Factories which are resuming operation, in most instances, are those which were first affected by the present reaction, while further declines are expected in lines which have not been affected up to this time. Credit still is restricted, and operating capital is difficult to obtain in the larger manufacturing centers. These signs all indicate that the readjustment period is not completed. A general feeling prevails that the full cycle will not be completed and sound business will not develop until such time as retailers, wage earners and producers alike accept their proportionate share of the national loss.

Prices of Raw Materials for Foundry Use

CORRECTED TO FEB. 7

Iron		Scrap	
No. 2 Foundry, Valley	$30.00	Heavy melting steel, Valley	$15.00 to 15.50
No. 2 Southern, Birmingham	28.00 to 30.00	Heavy melting steel, Pittsburgh	15.00 to 16.00
No. 2 Foundry, Chicago	30.00 to 31.00	Heavy melting steel, Chicago	15.50 to 16.00
No. 2 Foundry, Philadelphia	30.84 to 32.54	Stove plate, Chicago	21.50 to 22.00
Basic, Valley	28.00 to 29.00	No. 1 cast, Chicago	21.00 to 21.50
Malleable, Chicago	32.50 to 35.50	No. 1 cast, Philadelphia	23.50 to 24.50
Malleable, Buffalo	30.00 to 32.00	No. 1 cast, Birmingham	21.00 to 23.00
Coke		Car wheels, Iron, Pittsburgh	21.00 to 22.00
Connellsville foundry coke	$6.50 to 7.00	Car wheels, Iron, Chicago	22.00 to 22.50
Wise county foundry coke	7.50 to 8.50	Railroad malleable, Chicago	18.00 to 18.50
		Agricultural malleable, Chicago	18.00 to 18.50

Rigid Cost Factors

Foundrymen who are faced by an insistent demand for lower prices are in a difficult position, particularly when competition is keen. One large user of castings offered a northern Ohio jobbing foundry an exceptionally large gray iron order contingent upon a price which was only 50 per cent above 1913 quotations This particular foundry has made but slight reduction in wages, it still has a stock of $45 iron and $14 coke. With metal and fuel even at the present time almost double the 1913 figure and wages at least 70 per cent higher, the foundryman was unable to meet the customers price, and the order was not placed. Iron, scrap and coke all have descended very rapidly in price during the past two months. At the present time with an abnormally quiet market, a state of equilibrium seems to have been approached. Resales of iron from stock have ceased almost entirely, and a few new contracts for 1921 first half delivery have been entered upon by larger interests. Furnace interests state that at present prices they are unable to manufacture at a profit, and many have gone out of blast rather than pile iron and face future contingencies.

Iron Output Drops

According to figures compiled by *The Iron Trade Review,* the downward trend in iron production was continued in January. The total pig iron produced in January was 2,412,293 tons as compared with 2,700,268 tons in December. This is the lowest mark reached since the steel strike which affected the output most sharply in November, 1919. On Jan. 31, only 184 blast furnaces were in operation. This is a net loss of 21 for the month of January, and brings the total blown out or banked since Oct. 31 to 106 stacks. Merchant furnaces produced only 470,088 tons in January. This is a loss of 132,370 tons, compared with the December figure of 602,458 tons. The January daily average was 15,164 tons while that for December was 19,434 tons giving a loss of 4270 tons per day or almost 22 per cent. Four stacks making merchant iron were blown in during January and 15 blown out, making a net loss of 11 stacks. Southern pig iron has been purchased at as low as $27.50 furnace. Coke quotations likewise are lower and the demand has fallen away. Practically no future buying is noted in either coke or metals, although some prompt shipment materials are being purchased. The automobile situation is attracting much attention, due to the shows which are being held in the different large centers. These shows usually mark the beginning of the season's buying movement and in the past have constituted a barometer of future conditions. This year has been disappointing, due to the curtailed purchasing power of the public. It is stated that almost 13 per cent of the 1920 production of passenger automobiles remains unsold. This also will have an effect upon this year's production. Malleable castings manufacture has been affected strongly by the slump in automobile manufacture and absence of railway buying.

Malleables Slower

The December output of malleable castings was only 51 per cent of capacity, as shown by reports from representative interests. Agricultural implement demand is at a low point. Sugar refining machinery both for domestic and export use continues fairly active. Birmingham interests, have taken some work for Cuban shipment and some have entered into competition with northern manufacturers. Prices on nonferrous metals based on New York quotations in the *Daily Metal Trade* of Feb. 7 follow: Casting copper, 12.50c to 12.62½c; Lake copper, 13.25c to 13.37½c; lead, 5.00c; Straits tin, 32.50c; antimony, 5.25c; aluminum, No. 12 alloy, producers' price, 27.30c and open market, 20.00c to 22.00c. Zinc is 4.95c to 5.00c, E. St. Louis.

Comings and Goings of Foundrymen

H. W. UFER, recently elected president of the Chicago Foundrymen's club, illustrates the value of picking out the right job and staying with it. Mr. Ufer entered employ of the Griffin Wheel Co., Chicago, 19 years ago as a draftsman at the Chicago plant and rose by sheer merit through various grades until he was made superintendent. He was in charge of the Detroit and Denver plants for about one year each. After that he was made superintendent of the engineering and order division, with headquarters at the Sacramento avenue plant, Chicago, where he directs all of the 10 plants scattered across the country from Boston to Los Angeles. Mr. Ufer's connection with the Griffin Wheel Co. covers close to half his life.

Charles E. Desault has accepted a position as assistant foreman in the foundry of the American Machine Co., Pawtucket, R. I.

Carl Horix has resigned his position as vice president and general manager of the Toledo Bridge & Crane Co., Toledo, O.

H. O. Haeger, who for the past four years has been associated with the Abell-Howe Co., Chicago, in a sales capacity, has been appointed contracting engineer for that company.

F. W. Hall, of Cincinnati, has been elected president of the Ohio Sand and Gravel association, M. R. Evans, of Zanesville, vice president, and F. C. Fuller, of Portsmouth, secretary and treasurer.

L. R. Vernon recently has resigned his position as foundry foreman for the Lenore Care Works, Lenore, Tenn. Mr. Vernon formerly was general foreman for the American Machine & Mfg. Co., Atlanta, Go.

Lloyd R. Wallis, formerly superintendent of the roll department, the Youngstown Foundry & Machine Co., Youngstown, O., has been promoted to the position of secretary-treasurer of the same company. Mr. Wallis succeeds Bertram G. Parker, who has been advanced to general manager.

Samuel D. Sleeth, foundry superintendent, the Westinghouse Airbrake Co., Wilmerding, Pa., accompanied by Mrs. Sleeth, sailed from New York, Sunday, Jan. 30, for a three months' tour of Europe. The trip is given Mr. Sleeth as a token of the company's appreciation of his long service, he having been in the employ of the company for nearly 51 years. Mr. Sleeth is known as the originator of the continuous pouring system for foundries, having installed the first system of this kind in the foundry of the Westinghouse Airbrake Co.

C. A. Patterson, formerly secretary and general manager of the Fulton Foundry & Machine Co., Cleveland, has disposed of his interests in that firm and has been made secretary-treasurer of the Standard Sand Co., formerly the Standard Sand & Machine Co., of that city.

H. W. UFER
Recently elected president of the Chicago Foundrymen's club

Louis A. Way, who has been made assistant to the president of the Duquesne Steel Foundry Co., Pittsburgh, in charge of sales, formerly had been with the company 16 years before going with the Lewis Foundry & Machine Co., Pittsburgh, from which he resigned as works manager, Feb. 1.

Joseph G. Butler Jr. was re-elected president and treasurer of the Portage Silica Co., Youngstown, O., at the annual meeting of the company. E. E. Klooz retains the offices of vice president and general manager, and L. R. Farrell continues as general sales manager.

Horace Mager, formerly in the purchasing department of the Aluminum Co. of America, has become associated with the J. S. Morrison Co., Pittsburgh, to handle that company's eastern representation of the Marietta Mfg. Co., Point Pleasant, W. Va., selling structural and plate work and castings.

Frank Samuel, Harris building, Philadelphia, has been appointed American agent for the Newcastle Alloy Co., Ltd., Milburn House, Newcastle-upon-Tyne, and will sell low-carbon ferrochrome, ferrotungsten, ferromolybdenum, and 25 per cent and 12 per cent ferrosilicon.

James P. Salter has severed his connection with the Ohio Brass Co. to become plant superintendent for the Delaware Brass Co., Delaware, O., and foundry superintendent of the Regent Brass Co., Marysville, O. The former plant specializes in bath cocks while the latter makes basin cocks, bibs and general plumbers' supplies.

F. N. Pease, chief chemist of the Pennsylvania railroad, with headquarters at Altoona, Pa., has retired from active service in accordance with the pension regulations of the company. He has been succeeded by M. E. McDonnell, who was assistant chief chemist, and T. W. Fisher has succeeded Mr. McDonnell as assistant chief chemist.

Andrew G. Hill, president of the Malleable Iron Range Co., Beaver Dam, Wis., since 1902 retired from the office at the annual meeting in order to be relieved of the principal management responsibility. Fred W. Rogers, vice president, was advanced to president. His place is taken by Mr. Hill. John C. Zander, treasurer, and Arthur S. Bowron, secretary, are continued in these offices.

S. W. Dudley, Edgewood, Pa., has resigned, effective Feb. 1, as chief engineer of the Westinghouse Airbrake Co., Wilmerding, Pa. He has accepted a professorship of mechanical engineering at Yale university after 17 years of service which has brought him into prominence in steam and electric railway circles. Mr. Dudley commenced in 1903 as a special apprentice with the Westinghouse Airbrake Co. and was rapidly promoted. In 1914 he became chief engineer which title he retained up to the time of his resignation. He is a member of the American Society of Mechanical Engineers, the Engineers' Society of Western Pennsylvania, the New York Railroad club and the American Electric Railway and the Air Brake associations.

Elects New Officers

The American Malleable Castings association, at its recent meeting in Cleveland, approved the tax report of the National Industrial Conference board and, in part, the proposals submitted in a referendum of the Chamber of Commerce of the United States. Edwin E. Walker, vice president of the Erie Malleable Iron Co., Erie, Pa., was elected president; H. B. Parker, vice president and general manager of the Albion Malleable Iron Co., Albion, Mich., and Frank J. Eppele, president of the Trenton Malleable Iron Co., Trenton, N. J., were made vice presidents; and Robert E. Belt was re-elected secretary-treasurer. John A. Penton, Cleveland, the retiring president of the association, was elected honorary president. The following were made members of the research committee of nine for a term of three years: W. C. McMahon, vice president of the Northwestern Malleable Iron Co., Milwaukee; A. Aigeltinger, president of the American Malleables Co., Lancaster, N. Y. and J. S. Llwellyn secretary of the Chicago Malleable Castings Co, Chicago.

Supply Company Issues Handsome Catalog

An interesting and handsome volume recently brought out by the E. J. Woodison Co., Detroit, now is available. Not only is it a complete catalog of every conceivable item of supply and equipment used in ferrous and nonferrous foundries, plating and polishing rooms; but it also contains a great deal of useful information, tables, etc., which will make it a useful reference book to men responsible for the successful operation of foundries. It is an attractively bound volume, printed on heavy coated paper, 6 x 9 inches, 473 pages, besides 15½ pages devoted to a comprehensive index.

McLain's System Students Offered Medal

David McLain, McLain's System Inc., Milwaukee, who has been a leader in the foundry industry for many years has made a new departure by offering a medal and cash prizes to McLain students for various classes of semisteel castings, the best cupola practice, etc. A committee appointed by alumni of McLain's System will draft the rules and regulations governing the contest. The only restrictions placed by Mr. McLain are that no cerium, zirconium, titanium, vanadium or other alloys except ferromanganese or spiegel shall be used, and that the mixture shall consist of 20 to 40 per cent steel scrap and the remainder pig iron and semisteel or gray-iron scrap. These qualifications were introduced because Mr. McLain insists that manganese is the best deoxidizer for cupola metal, and also emphasizes the advantage of steel added to the mixture.

The object in offering the medal is to stimulate McLain students to greater achievements in following the methods taught them and in using individual initiative. Ever since 1873 when David McLain, then a boy 10 years old started to work in a foundry, he has been a student of foundry problems and has striven to assist others in learning the intricacies of the casting industry. He presented his first paper on semisteel 19 years ago, after having demonstrated that 30 to 40 per cent steel scrap, high manganese, correct charging and proper tuyeres with sufficient blast to maintain the correct balance between the carbon of the charge and the oxygen of the blast, produce a superior cupola metal. In 1908 Mr. McLain resigned his position as foundry superintendent to devote all his time to McLain's System and other interests. In his capacity as head of this organization he has taught more than 4000 foundrymen in all parts of the world. These students now will have opportunity to demonstrate the practical value of their instruction in open competition.

Will Hold Fall Meeting

Preliminary announcement is made that the Twenty-Fourth annual convention of the American Mining Congress will be held in Chicago next fall. A committee of twenty leading Illinois coal and iron producers, manufacturers and bankers is being organized by Francis S. Peabody, who will be general chairman. Convention headquarters already are open in the Congress Hotel and John T. Burns, assistant secretary of the Mining Congress, is in charge. Chicago's Coliseum, where the National Republican convention was held, has been leased and plans are being made to hold a national exposition of mines and machinery during convention week.

Industrial Cost Section Formed in New York

A New York section of the Industrial Cost association, with executive offices at the Peoples Bank building, Pittsburgh, was established recently at a meeting held in the Engineering Societies building, New York City. This section is the first of many to be established where organization work now is going forward simultaneously.

Officers of the New York section are: Chairman, M. M. Moore, New York representative, the Mesta Machine Co., Pittsburgh; vice chairman, E. S. Schench, auditor, Brunswick Refrigerator Co., New Brunswick, N. J.; secretary-treasurer, Fred G. Roberts, assistant comptroller, S-K-F Industries, 165 Broadway, New York City.

Speakers at the meeting were C. H. Smith, vice president of the Westinghouse Air Brake Co., Wilmerding, Pa.; A. A. Alles Jr., secretary-treasurer of the association; W. E. Hundley, Mesta Machine Co., Pittsburgh and Prof. W. Rautenstrauch, Columbia university, New York City.

The association aims to stimulate interest in correctly determined costs, to standardize cost and accounting terminology, and, in short, to deal with all phases of the cost problem of industry.

Transportation Governs Iron Costs

(*Concluded from page* 134)

increases always have been among the least variable of the factors of manufacturing expense; once effective, they seldom have been cut off.

How this has its cumulative force in pig iron is to be found in the case of iron ore. Many mining properties in the Superior region are operated on a royalty basis. These royalties are regulated by a sliding scale which is based on the delivered price of ore at lower lake ports. Higher transportation hence means higher royalties and increased costs of ore operations. This percentage increase in royalties today is much larger than the advance in the value of the ore itself.

Book Review

Foundry Molding Machines and Pattern Equipment, by Edwin S. Carman, cloth; 6 x 9 inches; 225 pages; published by the Penton Publishing Co., Cleveland, and furnished by THE FOUNDRY for $5 net.

In this second edition just published many of the details and ramifications of the art of machine molding are covered more completely than they were in the first edition. The book will be appreciated by those in the foundry industry who are desirous of changing their methods from hand to machine molding. It also will be of assistance to the manufacturer who wishes to have the members of his organization furnished with a complete and authoritative treatise covering in detail the

most approved methods pursued in pattern mounting and machine molding.

Chapter I, treating of the fundamentals of machine molding both elementary and advanced theory and practice, has been added with a view to meeting the needs of educational institutions. It is given to aid the many colleges, institutes, technical and trade schools which desire to give the student a training in up-to-date foundry practice; but are unable to do so because of a lack of sufficient data with which to prepare a course of study.

Believing that pictures are a great aid in the presentation of ideas the author has employed them freely to illustrate the method of mounting patterns and the making of molds by machine power. The different types of molding machines, together with the flask and pattern equipment necessary for their use are explained in such a way that the reader will receive a group of fundamental conceptions in regard to machine molding that will be of value to him in any line of engineering work in the foundry. To the practical foundryman, the book will shed considerable light on that most important question "will it be profitable to run this job on a machine, and if so, upon what type of machine?"

Will Meet in Chicago

The American Society of Mechanical Engineers will hold its spring meeting in the Congress hotel, Chicago, May 23 to 26. Professional sections on aeronautics, fuels, management, material handling, machine shop, power, forest products and railroads will be held.

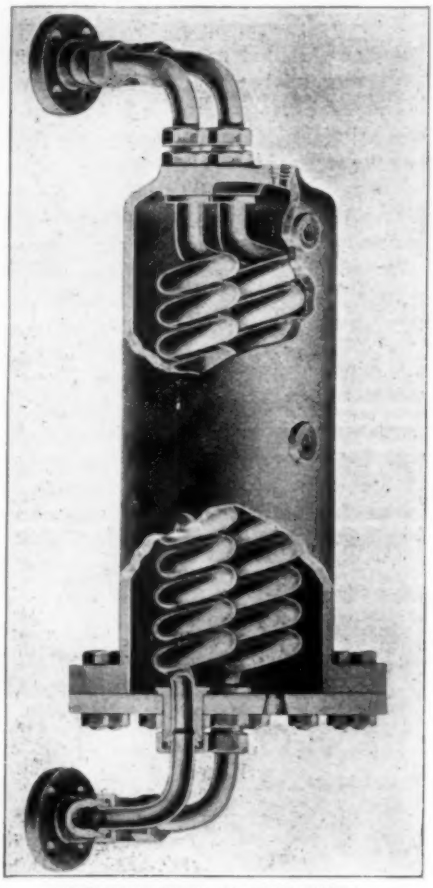
Addressed Pittsburgh Chemists

"Modern Developments in Metallurgical Research" was the subject of an address by Colin G. Fink, manager of laboratories, Chile Exploration Co., New York at a meeting of the Pittsburgh section of the American Electro Chemical society held Friday, Jan. 28.

Pennsylvania Council to Promote Safety

F. J. Lanahan, president, the Fort Pitt Malleable Iron Co., Pittsburgh, delivered an address on "Safety Methods in Cupola and Pouring Practice in Foundries" at the monthly meeting of the National Safety Council of Western Pennsylvania, Jan. 24. He pointed out that the greatest good in the safety first movement can come from company officials, from the president to foremen, inculcating in the minds of workmen the idea that human life is more precious than either success or profit.

More than 500 members were in attendance and heard the announcement by C. G. Clarkson that a bronze tablet, the gift of C. G. Rice, president of the safety organization in this territory, will be presented to the plant in Allegheny county making the best record in accident prevention during 1921 to "encourage the safety workers of the county to greater effort during the year."



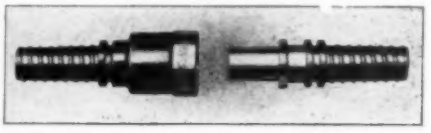
COIL-TYPE FUEL OIL PREHEATER

Preheats Cupola Fuel Oil

Fuel oil as furnished to foundries for use in cupolas is of a heavy grade and in order to insure proper vaporization, it is necessary to preheat this oil before it goes to the burners. To accomplish this heating, the Griscom-Russell Co., 90 West street, New York, has designed a heater of the coil type. As shown in the accompanying illustration, two spiral coils run vertically through the heater. High pressure steam passes around the coils the condensation being returned to the boilers. Precaution must be taken to prevent contamination of the high pressure condensate by the fuel oil, thus no oil joints are found inside of the steam space.

Air-Tight Hose Coupling

The air hose coupling with several new and important features shown in the accompanying illustration, has been placed on the market recently by the Ingersoll-Rand Co., 11 Broadway, New York. It consists of two parts, male and female. The female end is fitted with a V-shaped rubber gasket, which insures an air tight joint. The gasket is prevented from blowing out by a protective shoulder inside the coupling in the event that the coupling should be disconnected under pressure. There are no exposed parts on the female end which might be liable to injury, and cause jamming or sticking. The locking shoulders are heavy with large bearing surfaces. The locking spring is strong and durable, and may be replaced if necessary.



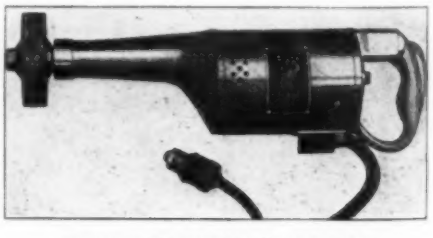
MALE AND FEMALE JOINT WITH LONG BEARING INSURES AGAINST LEAKS

The male end is provided with a long bearing to assure alignment and long wear. Another feature of interest is the absence of any outer sleeve exposed to injury. The air ports are straight and of uniform diameter. The coupling may be connected or disconnected by a quarter turn. A groove in the hose end of each part provides for the use of a hose clamp to attach it securely to the hose.

The couplins are manufactured in ½-inch and ¾-inch sizes, and are interchangeable. A ½-inch male connection may be used with a ¾-inch female connection. The gaskets also are interchangeable between the two sizes.

Small Portable Grinder

Designed for smoothing castings, and also for buffing and polishing, the small electric portable grinder shown in the accompanying illustration, is now manufactured by the Wodack Electric Tool Corp., Chicago. It is motor driven, using either alternating or direct current, and automatically stops when not in use. The current contact functions through a spring lever in the handle which is released as soon as the pressure of the



GRINDER FOR SMOOTHING CASTINGS

operators hand is removed from the handle. The grinder is made in three sizes corresponding to the size of wheel to be used, 3 x ½ inch; 4 x 1 inch, and 8 x 1 inch. As may be seen from the illustration, the motor is entirely enclosed. It runs in self-oiling ball bearings. The company states it has designed an effective motor to withstand severe use and overloading and has such faith in its product that it agrees to rewind them once free of charge should the armature, for any reason, burn out within a year.

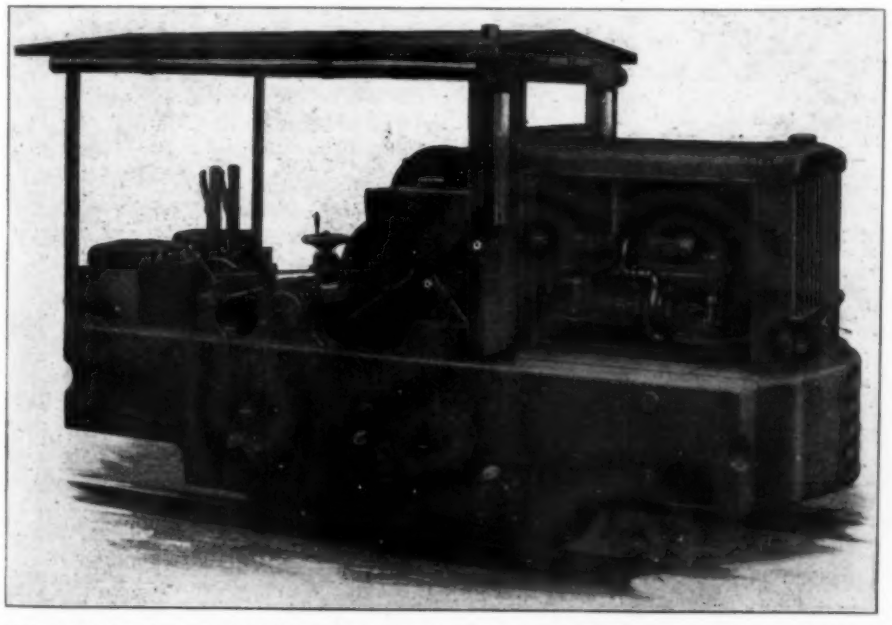
Gasoline Locomotive for Industrial Works

The gasoline driven locomotive shown in the accompanying illustration and designed especially for use in foundries, steel plants, brick and clay yards, sand and gravel plants, quarries, construction work of all kinds in connection with road building, mining and in fact any place where light haulage is required and industrial tracks are laid, is built in four sizes from 4 to 7 tons by the Hadfield-Penfield Steel Co., Bucyrus, O.

The speed of the locomotive can be graded from 0 to 12 miles an hour. The 23-horsepower engine on the 4-ton size when running at normal engine speed which in this case is 1000 revolutions per minute is capable of developing a draw bar pull of 1600 pounds. The length overall is 122 inches, the ottal height 72 inches and it is made in various widths to suit any gage from 50 to 63 inches.

Hyatt, self-aligning bearings prevent cramping on uneven rails. It is claimed that this feature adds materially to the life of the bearings and is a strengthening factor at a vital point. End thrusts in axles and jack shafts are taken up by bronze disks, located on the removable caps. The drive chain is totally inclosed in a dust proof housing provided with an oil bath in which the lower part of the chain always is submerged. The sanding arrangement is controlled by a hand lever. The sand boxes are out of the rain under the canopy of the locomotive and the discharge pipes are so arranged as to spill sand on the rail directly in front of each of the four wheels.

Power is transmitted from the engine by a friction drive, the friction being obtained by contact between a steel disk and a fiber insert on the fiber wheel. From the fiber wheel the power is transmitted to a jack shaft by a roller chain and from the jack shaft to all four wheels, giving a 4-wheel drive.



THIS GASOLINE DRIVEN LOCOMOTIVE IS BUILT IN FOUR SIZES FROM 4 TO 7 TONS THE SMALLEST SIZE DEVELOPS A DRAW BAR PULL OF 1600 POUNDS

PORTABLE CRANE IS OPERATED BY ITS OWN GASOLINE ENGINE OR ELECTRIC MOTOR

Builds Portable Crane for Handling Material

A portable crane operated by its own gasoline engine or electric motor and having functions similar to the larger types of locomotive crane, recently has been introduced by the Universal Crane Co., Cleveland. Depending upon the counterweight furnished, length of boom used, mounting and the radius at which the crane is working, the capacity is between 3 and 4 tons.

This crane, shown in the accompanying illustration, has a full circle swing and high speeds for travel, hoisting and rotating. A travel mechanism for moderate speed can be provided when the crane is mounted on a conveyance which has no other means of propulsion. A 40-horsepower, heavy-duty, 4-cylinder, slow-speed engine equipped with a governor drives the gasoline engine type crane while a motor of equivalent power

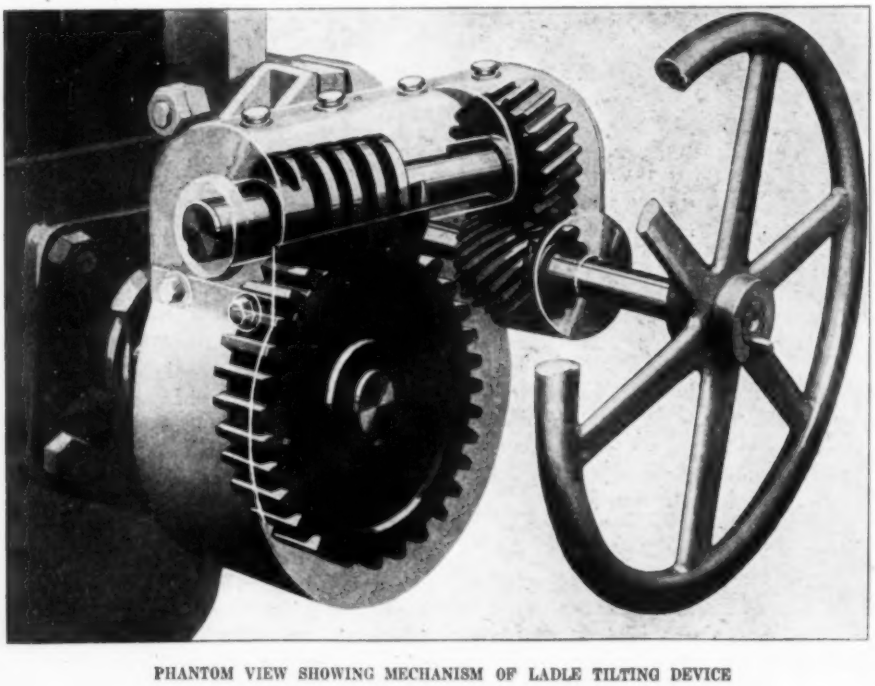
THE above illustration shows a wood turning lathe with 32-inch diameter swing which was built according to specifications written by the United States government in 1919. It is understood that the lathe which has a bed 62 feet long and is equipped with two power fitted carriages, will be used for turning the spars or masts. The lathe also is provided with two steady rests for supporting the long and heavy work. Each of the 44 men shown in the illustration participated in building the machine, which is the product of the Oliver Machinery Co., Grand Rapids, Mich., one of the two companies bidding for the contract.

operates the electric type. The boom, which is built of structural steel, may be varied in length to suit conditions. Various material handling equipment can be used to meet service demands, including grab buckets, electromagnets, hoist blocks, etc. The crane may be mounted as desired on a railroad flat car motor truck, trailer, caterpillar truck, portal pier, ground foundation, or on a steel wheel industrial truck with combination wheels for ground and track travel.

Ladle Gearing Is Mounted on the Trunnion

A design of crane ladle having the gearing attached to the trunnion as shown in the accompanying illustration recently has been developed by the Whiting Foundry Equipment Co., Harvey, Ill. Among the advantages claimed for the design are that any distortion of the bail or bowl will not interfere with the alignment of the gears neither will they be affected by wear on the trunnion journals. The gear combination has the self locking feature of worm gearing; but owing to the balance thrust obtained through the helical gears and because the efficiency of this gearing is much higher than ordinary worm gearing the power or force required to rotate the ladle is considerably reduced. The helical wheel on the hand wheel shaft meshes with a helical gear on the worm shaft. The worm wheel is adjusted at an angle so that the worm will properly mesh with a large spur gear keyed to the trunnion. The spur gear is a steel casting, the worm and helical gears are machined from solid forgings. All the gears have machine cut teeth.

The gear case is constructed to accommodate several different ratios of helical gears according to the speed desired. The gearing while completely enclosed in a dust proof cover is yet readily accessible for inspection. Small oil cups with spring caps provide ample lubrication. The design has been patented in the United States under letters patent 1323137 and 1357599.



PHANTOM VIEW SHOWING MECHANISM OF LADLE TILTING DEVICE

Obituary

Thomas T. Booth, purchasing agent, Crompton & Knowles Loom Works, died recently at his home in Worcester, Mass.

Samuel Khan, treasurer, the Estate Stove Co., Hamilton, O., died Jan. 20, on a train enroute from Cincinnati to Chicago. Mr. and Mrs. Khan were on their way to California for the winter.

Sir Frank Baillie, a prominent financier of Toronto, connected with many important industrial enterprises, died Jan. 2 after an illness of several weeks. He was 46 years old. In 1910 he organized the Burlington Steel Co. of Hamilton, and in 1912 the Dominion Steel Foundry Co. of the same city. Shortly after the beginning of the war he formed the Canadian Cartridge Co. of Hamilton, of which he was president, to manufacture cartridges for the British government, and in 1916 turned over to the government the profits of the enterprise amounting to $758,000. In the same year Sir Frank Baillis organized and became president of Canadian Aeroplanes, Ltd., manufacturing aeroplanes for war purposes. In recognition of his services he was created a Knight Commander of the Order of the British Empire.

John Sherwin, president of the Chicago Hardware Co., and the Lake County State bank, died at his home in Highland Park, Ill., Jan. 23, aged 61 years. Mr. Sherwin removed to Chicago from Cleveland in 1882, and a few years later was married to Elizabeth Englebrecht. In 1897 he organized the Chicago Hardware Foundry Co., and continued at the head of that establishment until his death. He was an active member of the Gray Iron Foundry association, Chicago Foundrymen's club, Machinery club, Illinois Manufacturers club and the Chicago Chamber of Commerce. He is survived by Mrs. Sherwin and three sons, Edward Bennett, Francis James and Raymond Felix.

Equipment Market Remains Inactive

Slight Stimulation of Foundry Operation Has Not Yet Been Noticeable in Demand for Plant Machinery—Some Projects Held in Abeyance Until Later

PRACTICALLY no important sales of foundry equipment are being made at present. Slight improvements in foundry operation through the East, and anticipated betterment in the Mid-Western sections have failed to react upon the foundry equipment market up to the present time. Price reductions in various items, and through entire lines have had little effect in stimulating demand, which in this period obviously can find its origin only with better market conditions for foundry products. Eastern equipment builders report a fair export inquiry. The Berkshire Mfg. Co., Cleveland, recently shipped four molding machines to Scotland, four to New Zealand and one to Australia.

Varied Outlook In Pittsburgh District

CONTRASTING conditions prevail in the foundry equipment market here. Some manufacturers state that inquiries are slow in developing and but few orders are being received, while others are able to report that inquiries are heavy and together with old orders, the new ones received from day to day are making them busier than at any time since the start of the war. This refers particularly to molding machines although there is some business pending on core making equipment, core ovens, ladles and sand mixing machinery. The Herman Pneumatic Machine Co. reports that it is busier than at any time in the past five years and is working on a number of large installations which in some cases marks the first installation of modern molding machines. Inquiries have been issued by the following companies: The Fox Furnace Co., Elyria, O.; McMyler Interstate Co., Bedford, O.; the Crane Co., Kadzie avenue plant, Chicago; the Griffin Wheel Co., Council Bluffs, Iowa, and the American Car & Foundry Co., Buffalo. Equipment is being installed this week in the new foundry of the Saco-Lowell Shops, Newton Upper Falls, Mass. The Lane Co., Detroit, is the engineer in charge of the building of this new plant. Installations likewise are about to be made by the Herman company in the new foundry of the Beaumont Iron Works, Beaumont, Texas, manufacturer of gas engines, pumps, oil well supplies, etc. On cranes, the market continues exceedingly quiet and while a few inquiries are current these continue to be held in abeyance and installations probably will not be made until the financial uncertainty under which the prospective users find themselves has been removed.

Quiet Prevails In East

THE eastern foundry equipment market is barren of live inquiry of consequence. There are various inquiries for one or two machines on which early action may be taken, but these still aggregate a relatively small volume. A recent order is said to be that of the M. W. Kellogg Co., Jersey City, involving two electric furnaces. Another is that of J. B. Wise, Inc., Watertown, N. Y., which comprises an electric melting furnace of the resistance type for installation in a brass works. Possibly the most interesting project to develop of late is that of the White Fuel Oil Engineering Corp., 742 East Twelfth street, New York. A new foundry is to be erected which will require approximately $45,000 worth of equipment. Of the sum to be expended, possibly half will be for cranes. Another project of interest to eastern sellers is that of the Frick Co., Waynesboro, Pa., although it has announced that no equipment will be bought at this time. In fact, it is doubtful if either of these two propositions will become active within the next month or two.

Little Activity In Chicago

INQUIRIES are slack throughout the Central West and Chicago foundry equipment manufacturers report little in immediate prospect. Replacement buying of flasks, ladles, and small sundries continues, but practically no cranes, melting units, or other important machinery are being sold. The Keith Furnace Co., Des Moines, Ia., which will be started later in the year will include a gray iron foundry. A new plant is under construction for the Miles Piston Ring Co., Chicago, which will have a capacity of 100,000 rings per day. The American Metal Products Co., Milwaukee, will proceed immediately with the erection of a new foundry and machine shop to cost $75,000. Kahlenberg Bros. Co., Two Rivers, Wis., recently increased its capitalization from $72,000 to $300,000 to provide for additional plant facilities later in the year. The company manufactures marine oil engines. William Kahlenberg is president. The Commercial Brass Foundry, 550 Fourth St., San Francisco, recently incorporated with a capitalization of $50,000 will purchase equipment to include furnaces and a traveling crane. C. F. Vonder Mehden is president.

What the Foundries Are Doing

Activities of the Iron, Steel and Brass Shops

The Eaton Electric Furnace Co., Taunton, Mass., has been incorporated with a capital stock of $95,000, by Harry B. Eaton, C. Eaton and Edwin S. Hope.

Capitalized at $10,000, the Metropolitan Iron Pipe & Nipple Works, New York, recently was incorporated by S. and P. Luke and B. Leibowitz, 6 Forsyth street.

C. & A. Potts Co., Indianapolis, plans the erection of a new foundry building.

The West Bridgewater Foundry, West Bridgewater, Mass., has arranged for the erection of a new foundry building, 50 x 100 feet. H. E. Bryant is superintendent.

The Fay-Kultzen Foundry Co., St. Joseph, Mich., recently changed its name to the Fay Foundry Co.

The Keystone Sand Co., 125 West Monroe street, Chicago, recently was incorporated with a capital

stock of $10,000, by Walter R. Werner, Edward A. Oliver and others.

Fire recently damaged the foundry of the R. P. Rob Power Co., Worcester, Mass.

Randolph Ember, 209-11 King street, Brooklyn, N. Y., is reported planning the erection of a foundry, 57 x 96 feet.

Erection of a foundry, 100 x 200 feet, is reported to be under consideration by the Albert Lea Foundry Co., Albert Lea, Minn.

The Dill Foundry Co., Rushville, Ind., recently was incorporated with a capital stock of $20,000, by William F. Dill, H. G. Francis and G. J. Greisser.

E. J. Danberg, 406 Stanley street, New Britain, Conn., and others, is reported planning the erection of a foundry building, to be 30 x 30 feet.

The Glamorgan Pipe & Foundry Co., Lynchburg, Va., is reported planning the erection of an addition to its foundry.

The U. S. Electric Steel Products Co., Mills building, San Francisco, is at work on plans for its new plant to be erected at Sacramento, Cal.

The Rees Blow Pipe Mfg. Co., 340 Seventh street, San Francisco, is reported planning to enlarge its foundry building.

The Advance Foundry Co., Dayton, O., has plans for the erection of a plant building, 40 x 70 feet.

The Topeka Foundry & Iron Co., Topeka, Kans., has purchased 12 city lots, which it will utilize as a site on which to erect a plant addition.

The Moulds Brass Foundry, Benton Harbor, Mich., is building a new works, which is expected to be completed shortly.

The Globe Duluth Iron Works, Duluth, Minn., plans to remodel a building for use as a foundry and machine shop.

The Peoria Malleable Castings Co., Peoria, Ill., is doubling the output of its plant by the installation of a 25-ton furnace.

Capitalized at $10,000, the Oxford Brass Foundry, Philadelphia, recently was incorporated by Nathan Glanzberg, Martin Stein and others.

Horace T. Potts & Co., 315 North Third street, Philadelphia, is reported planning the erection of a foundry building.

Plans have been completed by the Baltimore Car & Foundry Co., Baltimore, for the erection of an addition to its plant.

Capitalized at $200,000, the Krasberg Piston Ring Co., 536 Lake Shore Drive, Chicago, recently was incorporated by Herbert Bebb, R. Krasberg and Julius Keller Sr.

The capital stock of the Buckeye Castings Co., Lima, O., recently was increased from $25,000 to $200,000, and it is reported the company is planning the erection of a new foundry building.

The Eastern States Sand & Gravel Co., New York, recently was incorporated with a capital stock of $500,000, by J. Constantine, B. D. Bugundji and A. Scher, 1013 Simpson street.

The Taunton Casting Co., Taunton, Mass., has been incorporated with a capital stock of $25,000, by Joseph P. McKenna, Wilbur E. Forbes and E. Owren, Attleboro, Mass.

The M. & S. Mfg. Co., Worcester, Mass., recently was incorporated with a capital stock of $10,000, to engage in the manufacture of castings, tools, pumps, etc., by Morris F. Strogoff, 5 Ivanhoe road, and others.

The Bergen Point Brass Foundry, 161 Hobart avenue, Bayonne, N. J., recently filed notice of organization to manufacture brass, bronze and other metal castings. Albert W. Lindberg, 125 West Sixth street, is among the organizers of the company.

The Portsmouth Metal & Foundry Co., Portsmouth, Va., has plans under way for rebuilding its foundry at King street and Louisa avenue, which was recently damaged by fire. A. V. Moore is president of the company.

Advices have been received to the effect the name of the Huntington Steel Foundry Co., Huntington, Ind., has been changed to the Armstrong Steel Castings Co. The company makes steel castings and has a modernly equipped plant. L. R. Wright is one of the officers.

The new plant of the Standard Chilled Castings Corp., Lynchburg, Va., recently organized, will comprise the factory of the Dawson Bros., which has been acquired. It will be remodeled and converted into a foundry for the manufacture of agricultural equipment including plow parts, etc. J. L. Thomas is secretary of the company.

Advices have been received from the Schlangen Bros. Co., 2435 Irving Park boulevard, Chicago, manufacturer and finisher of brass products, to the effect it has increased its capital stock from $50,000 to $100,000. Officers of the company are: President, N. A. Schlangen; treasurer, Carl Schlangen, and secretary, E. C. Roos.

For the purpose of caring for a large business done in the territory of which Chicago is the natural distributing point, the Stockham Pipe & Fittings Co., Birmingham, Ala., has incorporated in the state of Illinois, the stock of the Illinois corporation being placed at $507,350. The company's Chicago warehouses will serve the five surrounding states.

For the purpose of financing the expansion of its business, the Rudy Furnace Co., Dowagiac, Mich., recently increased its capital stock to $650,000. These expansion plans, to a large extent, still are indefinite, and consequently the company at present is not in the market for additional machinery and apparatus, according to advices from A. F. Frazee, secretary.

Members of the Chas. Jurack Pattern Works, 199 Oregon street, Milwaukee, have organized a new organization, known as the Standard Die Cutting Co. The company, which is capitalized at $100,000, will engage in the manufacture of dies, die castings and similar articles. The incorporators are Charles Jurack Sr., Charles G. Jurack and William R. Jurack.

Repairs have been made to the plant of the Nekoosa Iron Works, Nekoosa, Wis., which was recently damaged by fire, and the company is now operating in all departments. The fire completely destroyed the brass foundry and considerable damage was done to the iron foundry. Equipment was damaged to the extent of $1000 while the building loss was estimated at $4000.

Announcement has been made by the Twin Ports Steel & Tractor Co., Superior, Wis., to the effect it has taken over the Evered Foundry & Machine Works, also of Superior. The company also announced that in addition to manufacturing gas tractors, hoisting engines and power winches, it is in a position to take on foundry and machine work. In connection with its foundry, it is operating a completely equipped pattern shop.

The Commercial Brass Foundry, 550 Fourth street, San Francisco, has advised it has incorporated with a capital stock of $50,000, and is planning to purchase additional equipment and to further the sale of its various brands of bushings. In addition, the company plans to change its name to the Commercial Brass & Bronze Foundry. New equipment to be installed will include furnaces and a traveling crane. Officers of the company are: President, C. F. Vonder Mehden; vice president and treasurer, E. G. Soeth, and secretary, Mrs. C. Soeth. The directors are E. G. Soeth, C. F. Vonder Mehden and William Barker.

Piston rings will be manufactured in a new plant building now under construction at Fifty-fourth and State streets, Chicago, for the Miles Piston Ring Co. The building will be one and two stories, 100 x 161 feet, and will be equipped with modern appliances. When operating at capacity the plant will have an output of 100,000 piston rings daily. In planning the structure, the company has provided for the installation of shower baths, rest rooms and lunch rooms for its employes. The upper floor of the building will house the executive offices while the back end of the roof will be used for storage outside. The entire lower floor will be used as the factory.

Because of the improvement in its business and better prospects, the American Metal Products Co., 671 Kinnickinnic avenue, Milwaukee, will proceed immediately with its project of erecting and equipping a foundry and machine shop on a new site. It was originally intended to start work last fall. The main shop will be 80 x 220 feet, of brick and steel, with metal sash, located on a tract of six acres, which provides ample room for future expansion. The present construction and equipment work will cost about $75,000. The officers of the company are: President, George F. Staal, city engineer of Milwaukee; vice president, W. J. Eberle; and secretary-treasurer and general manager, Carl J. Zaiser.

At a recent meeting of the stockholders of the Lumen Bearing Co., Buffalo, it was decided to double the present capitalization of the company, in order to enable it to develop its plant and equipment for handling the increased volume of business. Besides its Buffalo plant, the company operates a plant at Youngstown and the total capacity of the two plants is 15,000,000 pounds of brass and bronze castings, solders, babbitts and ingot metals a year.

Resumption of the manufacture of cast aluminum plates and bronze gear blanks, has been effected by the Ann Arbor Metal Products Corp., Ann Arbor, Mich., which recently was completely reorganized. James H. Collins, formerly manager of the Elwell Trolley Supply Co., Ann Arbor, has been made trustee and manager of the company. John Chapin is superintendent and Roy Court, George Maulbetsch, Carl Hickesson and Frank A. Stevens are other executives of the organization. The company, to a great extent, is to be run on a co-operative plan with the employes. At present it is occupying the leased premises of the Elwell Trolley Supply Co. and will continue to do so until a suitable site can be obtained. The company has started work on a number of large orders which have accumulated during the past few weeks.

Bids will be called for shortly by Carl C. Ade, Rochester, N. Y., for the erection of a plant consisting of two units, for the Wayland Specialty Mfg. Co., Wayland, N. Y., manufacturer of automotive accessories and specialties. The two buildings will be 60 x 200 feet each, but the main factory unit will be two stories and the other one story. Forty feet in the front of the latter building will be used as a power plant, while the remainder of the building, 60 x 160 feet, will be utilized for a foundry, which will be devoted to small work. The Wayland company owns a 15-acre site. A railroad siding will run between the two plant buildings and to the north will be another spur, elevated 12 feet, for fuel, coke and metals. In planning the building the company has taken into consideration the future expansion possibilities. The company besides maintaining an office at Wayland, N. Y., has an office at 907-909 Ashland block, Chicago. Officers are: President, Charles L. Clark; secretary, Edward H. Perkins, and treasurer, C. S. WeMett.

New Trade Publications

GASOLINE LOCOMOTIVE — The Hadfield-Penfield Steel Co., Bucyrus, O., which some time ago absorbed the American Clay Machinery Co., has published an illustrated booklet in which gasoline locomotives, designed for the requirements of every industrial activity, are described and illustrated.

LADLES—The Whiting Corp., Harvey, Ill., is circulating a 32-page illustrated booklet in which ladles and ladle accessories and equipment are described and illustrated. Of particular interest is the new style helical-worm geared crane ladle, which is described in detail. Heretofore the tilting mechanism on geared ladles has been fastened to the bail and as a result any distortion of the bowl or bail from expansion, due to heat, resulted in the gearing being more or less drawn out of alignment, and made tipping more difficult. To overcome this, the company has developed a new tilting mechanism, which is an entirely self-contained unit supported by the trunnion. The engagement of the tilting mechanism with the bail is such that any warping does not affect the alignment of the gearing. The mechanism is described in full, as are various other types of ladles and equipment. The bulletin supersedes one published some time ago, when the company was known as the Whiting Foundry Equipment Co.